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Issued March 26, 1952

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RED-FRONTED PARROT
AMAZONA FINSCHI
One-half natural size
Painting by Andrew Jackson Grayson

THE CONDOR

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THE JAWS OF THE CRETACEOUS TOOTHED BIRDS, ICHTHYORNIS AND HESPERORNIS

By JOSEPH T. GREGORY

The remarkable Cretaceous birds with teeth, widely cited in paleontological and biological literature as an intermediate evolutionary stage between reptiles and modern birds, are known almost exclusively from the monograph "Odontornithes" and a few preliminary publications by O. C. Marsh, their discoverer. Marsh's reconstructions have been copied extensively and formed the basis for discussions of relationships by Fürbringer, D'Arcy Thompson, Lucas, Wetmore, and others. Heilmann, Lucas, and Shufeldt have attempted revised restorations, but none of them had access to Marsh's original specimens. Recently the writer had occasion to examine the type of *Ichthyornis dispar* Marsh and was so impressed with the resemblance of the lower jaw to that of a mosasaur, that the entire collection was carefully scrutinized for evidence that might demonstrate whether the jaws really belonged to the bird skeleton or were in fact immature mosasaur jaws which had been deposited with bird bones of similar size. The results of this investigation confirm Marsh's statement (1880:124) that "the dentigerous portion of the lower jaw [of *Ichthyornis*] is so similar to that of some of the smaller Mosasauroid Reptiles, that, without other portions of the skeleton, the two could hardly be distinguished."

This conclusion is not to be lightly accepted as merely indicative of the reptilian origin of birds. Much evidence (reviewed by Heilmann, 1927) has been accumulated which indicates that birds are descended from some stock of archosaurian reptiles akin to the dinosaurs and crocodiles. Mosasaurs, on the contrary, were specialized Upper Cretaceous lizards only distantly related to the archosaurs. Their peculiar jaw structure had been recently acquired and is neither shared with other lizards nor found in any other group of reptiles. The Cretaceous diving bird *Hesperornis* possessed a transverse intramandibular joint analogous to that of the mosasaurs, a remarkable example of evolutionary convergence. The jaw assigned to *Ichthyornis*, on the contrary, is so closely similar to that of the mosasaur *Clidastes* in details of structure, that actual relationship rather than convergence is suggested. Its association with the bird skeleton seems extremely doubtful.

Mosasaurs are the most abundant fossil reptiles in the Niobrara Chalk of Kansas, the formation which yielded the remains of both *Ichthyornis* and *Hesperornis*. They were large aquatic lizards, from six to thirty-five feet long; three genera, *Clidastes*, *Platycarpus*, and *Tylosaurus* are abundant and well known. No small specimens have been reported, and Williston commented (1898:213) on the absence of young individuals. Although the difference in size between the "*Ichthyornis*" jaw and those of the mosasaurs seems enormous, the former is not too small to have belonged to a newly born (or hatched) mosasaur. Moreover, it seems incongruously large for the delicate bird

skeleton with which it has been associated. The possibility that these jaws are in fact those of a young mosasaur should be seriously considered.

Evaluation of the characters of the "*Ichthyornis*" jaw necessarily led to detailed comparisons with *Hesperornis* and a new reconstruction of the jaw of that bird has also been attempted. It is hoped that the additional data will be of use to future students of fossil birds. The paucity of specimens upon which these reconstructions are based should be emphasized. Only the imperfect pair of jaws associated with the type of *Ichthyornis dispar* Marsh (Yale Peabody Museum no. 1450) is sufficiently complete to yield critical information about this form. *Hesperornis regalis* Marsh (Y. P. M., no 1206) and *H. gracilis* Marsh (Kansas University Museum of Paleontology no. 2287) have relatively complete though disarticulated lower jaws, and *H. crassipes* Marsh (Y. P. M. no. 1474) includes the anterior part of an angular and a fragment of a dentary. No other jaw remains of *Hesperornis* have been recorded.

Lucas (1903:552) proposed the genus *Hargeria* for *Hesperornis gracilis*, on the basis of the form of its quadrate, short nasal processes, and proportions of the femur. Comparison of the quadrates with that of *H. regalis* fails to support his view, which was based on comparison with Marsh's illustrations. The proportions of the femora may easily have been altered by crushing.

In the course of this study I have been encouraged and aided by suggestions received in discussions with Dr. Hildegarde Howard, Prof. Glenn L. Jepsen, Dr. S. Dillon Ripley, Prof. A. S. Romer, and Dr. Alexander Wetmore. Dr. Howard kindly read the manuscript and furnished valued criticism. The illustrations have been prepared by Miss Shirley Glaser, staff artist of Yale Peabody Museum. Drs. R. W. Wilson and Frank Peabody have permitted me to examine and figure the jaw from the well preserved *Hesperornis* [*Hargeria*] *gracilis* skull in the University of Kansas Museum of Natural History.

THE JAWS OF ICHTHYORNIS

Ichthyornis dispar Marsh was described (Marsh, 1872*a*:344) in October, 1872, on the basis of biconcave vertebrae, wings and legs (Y. P. M. no. 1450). In November, 1872 (Marsh, 1872*b*:406), a lower jaw was described as *Colonosaurus mudgei* Marsh and was compared with mosasaurs. In February, 1873, Marsh (1873:161-162) stated that *Ichthyornis dispar* had well developed teeth in both jaws, and further: "When the remains of this species were first described, the portions of lower jaws found with them were regarded by the writer as reptilian [a footnote cites the description of *Colonosaurus mudgei*]: the possibility of their forming part of the same skeleton, although considered at the time, was not deemed sufficiently strong to be placed on record. On subsequently removing the surrounding shale, the skull and additional portions of both jaws were brought to light, so that there cannot now be a reasonable doubt that all are parts of the same bird." In a later paper Marsh again (1880:124, *inter alia*) noted the resemblance of the jaw to that of mosasaurs.

Some years after Marsh's death the specimen of *Ichthyornis dispar* was mounted in a plaster plaque; today therefore we have only Marsh's statement of the association of the jaw with the remainder of the bird skeleton. The right jaw is mounted, median side exposed, in the plaster plaque; the left is free from matrix and lacking the articular end but preserves the joint between angular and splenial.

In addition to jaws found with the type of *Ichthyornis dispar* (Y. P. M. no. 1450), Marsh noted two other jaw fragments of similar size, Y. P. M. nos. 1749 (*I. anceps*) and 1735 (*I. victor*). The latter was an isolated specimen, not associated with any avian bones; the former bears the same number as a bird humerus, but there is no proof of

association. They include the posterior portions of dentaries and splenials which agree, so far as they go, with the jaws of *I. dispar,* no. 1450; however, the splenial articulation is missing. The anterior end of a dentary of small size, Y. P. M. no. 1775, is sup-

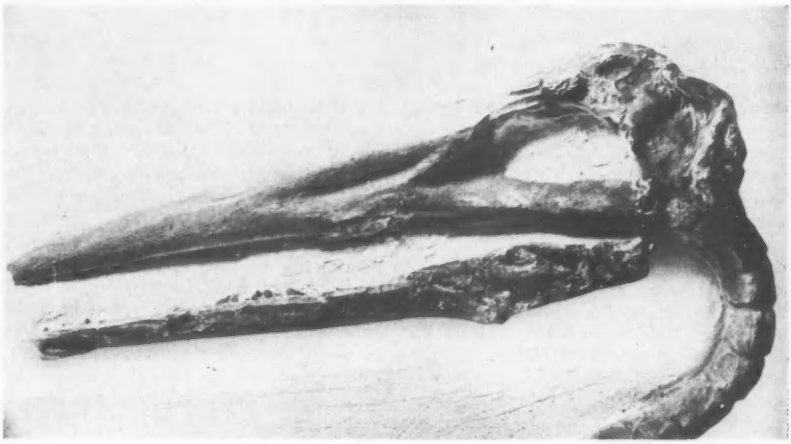


Fig. 1. Skull of *Ichthyornis dispar* Marsh as mounted and restored in Yale Peabody Museum; internal side of right mandible is shown; × 1½.

posedly associated with quadrates and other diagnostic bird bones, but again contacts and proof of association are lacking. These fragments can throw no light on the problem of the relationships of *Ichthyornis* and are not further discussed.

The lower jaw of *I. dispar* (Y. P. M. no. 1450), is 68 mm. long; of this the anterior dentigerous portion forms 50 mm. The two sides are closely similar in size. The anterior section, which consists of splenial and dentary, articulates with the posterior part, composed of angular, surangular, articular, prearticular, and coronoid. There is no symphysis between the left and right rami of the mandible.

Fig. 2. Left lower jaw of "*Ichthyornis dispar* Marsh"; external side, × 1½.

Articular.—The articular is preserved only on the mounted right jaw (figs. 1, 3); its inner aspect is visible. The cotylus lies at the extreme posterior end of the dorsal surface; it is transversely elongate, concave fore and aft, and slightly constricted lateral to its center by a projection from the anterior edge. Traces of a suture separating articular from surangular may be seen; it runs from the medial surface of the jaw above and in front of the base of the medial articular expansion, upward and backward to the upper edge of the jaw and back toward the lateral posterior corner. The surangular forms the anterolateral portion of the cotylus. This is precisely the relationship in mosasaurs (see figs. 6 and 9).

Behind the cotylus the posterior end of the articular drops abruptly, at right angles to the dorsal border, forming the posterior end of the jaw. There is some crushing in this area, which bears little resemblance to any other form. It is slightly hollowed out for the insertion of the m. depressor mandibuli, with two pockets, the lateral much wider than the medial.

Angular.—Commencing beneath the articular as a thin sheath along the ventral edge of the mandible, the angular increases in size as it extends forward beneath the surangular. One and one-half centimeters ahead of the posterior end of the jaw it abruptly turns downward and terminates in the thick rim of the intramandibular articulation. The articular face is asymmetrical, projecting forward laterally into the cup at the back of the splenial; it is excavated medially to accommodate the medial projection of that bone. On the free left jaw, the articulation with the splenial is similarly developed. The lateral surface shows a faint suture between surangular and angular near the ventral edge. Thus the relations are similar to mosasaurs throughout. It must be emphasized that the anterior position of the angular, which does not reach back to form the retroarticular process, is very different from that of modern birds, of *Hesperornis,* or of any of the archosaurian reptiles from which birds originated.

Prearticular.—On the right mandible the prearticular is seen to be a flat plate of bone, wedge-shaped anteriorly, tapering to a projection which is inserted between the splenial and the dentary just behind the last tooth. Its dorsal border closely parallels the upper edge of the surangular as far back as it can be traced. The ventral edge lies close above the articular on the medial side in the region of the joint. Posteriorly it is impossible certainly to distinguish the upper edge of this bone as the coronoid(?) is crushed over the medial surface of the jaw. Ventrally it continues back beyond the angular and fuses with the articular to form the posterior end of the jaw. The relationship to the angular is identical with that found in mosasaurs and is quite unlike the condition in birds, in which the prearticular is entirely forward to the articular cotylus.

The well developed, thin, but wide prearticular that extends forward beyond the intramandibular articulation and inserts between splenial and dentary is identical to that of mosasaurs. Williston (1898: 131) emphasizes that this thin bone must have been flexible in the lateral plane and probably was instrumental in springing the jaws back into normal extension after flexion.

Surangular.—As in mosasaurs, the main element of the angular complex is the surangular, which forms nearly all the outer side of the jaw behind the dentary. Only its dorsal edge can be seen clearly in the right jaw. Between the angular cotylus and a point above the intramandibular joint it is gently convex and smoothly rounded. Directly over the joint it is concave for a short distance, beyond which it is essentially straight, in continuation with the upper border of the dentary. On the right mandible the surface of the concave section is pitted by minute vascular foramina; on the left there are fine ridges running longitudinally, slightly downward toward the front, indicating the position of the suture with the coronoid. No distinct dorsal process of the surangular rises behind the coronoid suture as in adult mosasaurs, but in such a young individual this process might easily be represented by the faint convexity of the bone in this region. Anteriorly the surangular extends well beyond the intramandibular joint and is embraced between the medial and lateral processes of the dentary.

Nothing can be said of the mandibular foramen of *Ichthyornis,* for the left jaw is broken off shortly behind the articulation with the dentary, and the area in which it might occur on the right jaw is concealed beneath another fragment of bone, mentioned beyond as a possible coronoid, for most of the distance between articular and dentary. It is obvious that there is none along the surangular-dentary suture. Marsh (1880:123) states that there was none, which is probably correct.

Coronoid.—A fragment of bone lies on the medial surface of the right jaw behind the intramandibular joint, below and slightly behind the position occupied by the coronoid in mosasaurs. It swells from a rounded point (directed backward as it lies) into an element of asymmetrical U-shaped cross-section which might be considered a mosasaur coronoid with undeveloped posteriomedian process were it not for its massiveness which seems excessive for a jaw of this size. Whether this bone belongs with the rest of the jaw or is an extraneous fragment cannot be positively determined. But whether it is or not, the presence of a suture on the upper edge of the surangular indicates that a coronoid was present, and in the position characteristic of mosasaurs. Inasmuch as this element is frequently detached from much larger mosasaur specimens, its loss from this jaw is not surprising.

Splenial.—As in mosasaurs, the posterior end of the splenial is thickened and forms the entire

rounded lower surface of the jaw for a short distance, projecting behind the dentary to its facet for the angular. As in mosasaurs (see fig. 3), the medial half of the facet is convex, the lateral concave. Sutures between dentary and splenial are almost impossible to distinguish in these specimens. On the left jaw a small crack 2 mm. long on the external surface just above the articular enlargement of the

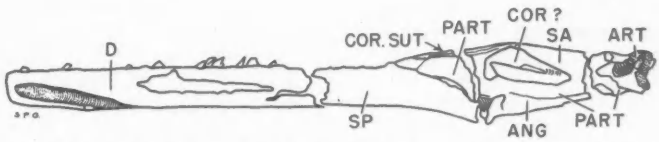
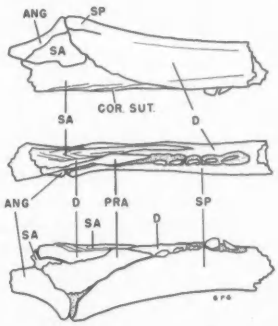


Fig. 3. Medial view of right lower jaw of "*Ichthyornis dispar* Marsh," × 1½; ANG angular, ART articular, COR? coronoid?, COR SUT coronoid suture on surangular, D dentary, PART prearticular, SA surangular, SP splenial.

splenial may indicate the beginning of the spleniodental suture; if so, the relationship is exactly as in mosasaurs. A displaced flake of bone on the right mandible just below the last tooth gives a strong suggestion of a squamous suture between the thin dorsal edge of the splenial and the inner surface of the dentary. Near the anterior end of the right splenial, along the lower edge of the jaw, further trace of the suture may be seen. On the left jaw, the suture was observed in cross-section at the more anterior of the two transverse breaks; here the splenial forms a thin plate on the inner surface of the



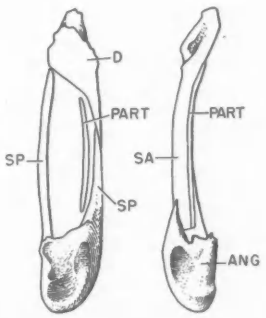


Fig. 4, left. Region of intramandibular articulation of left jaw of "*Ichthyornis dispar*" shown in external (above), superior, and internal (below) views, × 2.

Fig. 4, right. Intramandibular articulation of *Platycarpus ?coryphaeus* Cope; posterior view of dentigerous portion of mandible showing form of splenial articular surface (left), and anterior aspect of posterior portion of jaw showing articular facet on angular (right); based on Y.P.M. no. 3690, ×½.

jaw. None of the evidence conflicts with interpreting the splenial as having exactly the same relationships as those of mosasaurs. Nevertheless, the obscurity of this suture is noteworthy, especially in so young an animal.

Dentary.—Almost the entire upper edge of the slender dentary is occupied with the 22 sockets for teeth. The shape of these alveoli has been adequately described by Marsh (1880, pl. 21, fig. 3) except that the interalveolar septa are thinner than his figure shows. The dentary tapers very little compared to that of any adult mosasaur, a condition which may be reasonably attributed to immaturity. At the posterior end the dorsal margin slopes downward gradually to just above the intramandibular joint where it ends, on the lateral surface, against the rounded splenial. This portion of the dentary is bifurcated to hold the anterior end of the surangular.

A deep canal along the lateral surface of the posterior half of the dentary tapers somewhat anteriorly and then enters a foramen in the side of the bone. It is continued forward on the surface by a shallow, narrow, parallel-sided groove which extends to the tip of the jaw, and along which the series of six mental foramina open. Comparison with available mosasaur jaws suggests that the groove might be due to crushing of the internal mandibular canal, but the smooth, rounded surfaces and perfectly formed foramen by which it enters the jaw seem to oppose this hypothesis. However, farther back, there is evidence of inward crushing of the lateral face of the dentary.

On no. 1735, a portion of a mandible similar in size and character to no. 1450, the transition from groove to canal beneath the mental foramina occurs in the same region, but in it there is suggestion of crushing. There is no trace of a suture between the splenial and the dentary in this fragment.

Fig. 5. External view of left lower jaw of "*Ichthyornis dispar* Marsh," × 1½.

Near the front of the right jaw, a deep groove for the anterior end of Meckel's cartilage runs upward and forward from the lower border to the symphysial region. This is exactly similar in position to the internal mandibular groove in the anterior end of mosasaur jaws. Marsh's statement (1872*b*:406) that the jaws lack the internal groove is in error but it may have been prompted by examination of the left mandible, in which the groove is much shallower. Here it runs forward from a foramen at the presumed anterior end of the splenial and becomes obsolete before reaching the symphysial area.

As in mosasaurs, there is neither suture nor symphysis between the anterior ends of the mandibular rami. Weak roughening of the medial surface of the dentary indicates a ligamentous attachment. In front, the dentary terminates quite abruptly in a nearly vertical face.

Dentition.—Marsh correctly noted the presence of 21 alveoli in the dentary of "*Ichthyornis dispar*," and claimed 22 in "*I. anceps*," no. 1749 (1880:124-125). The teeth remaining in the jaw show compressed, recurved tips with sharp anterior and posterior cutting edges. An alternating tooth succession typical of many reptiles is indicated, for partly erupted crowns protrude from alternate alveoli, commencing with the first. Careful excavation of some of the empty intervening alveoli has revealed tips of unerupted teeth. No fully erupted teeth are present, which may account for the absence of the swollen bony bases so characteristic of mosasaur teeth. It has long been known that these bases, which unite the tooth to the jaw bone, were resorbed as teeth were shed and are not found in empty alveoli. It seems probable that the partly erupted teeth may be the first successional dentition. This would account for the absence of bony bases and for any trace of predecessors to the even-numbered tooth rudiments.

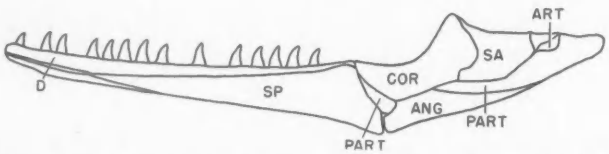


Fig. 6. Medial view of lower jaw of *Clidastes tortor* Cope, after Williston, × ⅛; COR coronoid, other abbreviations as in Fig. 3.

The number of teeth, 21 or 22, is significant for determining the relationships of this jaw fragment. Among the American mosasaurs the numbers of mandibular teeth reported are as follows: *Clidastes* 18, sometimes 17; *Platycarpus* 10 to 12, most frequently 11; *Tylosaurus* 13. Little information is available concerning variability of tooth number among mosasaurs. However, among recent thecodont reptiles there is some variation in tooth number. It is not unreasonable to suppose that

some individuals of *Clidastes* had 21 or 22 mandibular teeth. The resemblance of the "*Ichthyornis*" jaw is unquestionably closer to *Clidastes* than to any other known mosasaur genus in this respect.

In view of the antiquity of *Ichthyornis*, and the retention of such primitive features as biconcave vertebrae in its skeleton, an interpretation of its jaw morphology requires more than merely weighing its resemblances to modern birds and reptiles, for the retention of some reptilian features in an archaic bird is easily conceivable.

Accordingly, it will now be shown that the "*Ichthyornis*" jaw is not only more reptilian than avian in its morphology, but also differs from the jaws of archosaurian reptiles in most of the features which distinguish it from birds. A detailed analysis of the jaw of *Hesperornis*, another Cretaceous bird, shows that definitive avian characteristics were already present, despite the retention of teeth.

Finally, the complete agreement of the "*Ichthyornis*" jaw with that of mosasaurs in a number of distinctive features conclusively shows its relationship.

Evaluation of the unusual features of the "*Ichthyornis*" jaws requires an analysis of the jaw structure of both recent birds and of the archosaurian reptiles which gave rise to birds. As the reptilian jaw is the more complex, it will be convenient to describe it first and then attempt to show how birds differ. The rami of an alligator's jaws are united by an interlocking suture between the anterior ends of the dentaries, and in most genera also of the splenials. Each ramus consists of seven ossifications which normally are separated by sutures throughout most of the life of the animal. The large external mandibular foramen lies between the angular, surangular, and dentary. The coronoid is small, forming part of the inner wall of the large Meckelian canal. The angular forms an extensive suture with the posterior end of the dentary, extending forward between it and the splenial for some distance. The latter bone is confined to the medial surface of the jaw. There is no coronoid process (except in *Ornithischia*), the closure of the jaws being accomplished largely by the pterygoideus muscles which enter the mandibular canal.

Modern birds have a mandible whose two rami are indistinguishably fused in the anterior symphysis. Dentary, splenial, surangular, angular, prearticular, and articular elements develop in the embryo but are largely fused together in the adult. There is no separately ossified coronoid. The jaw is laterally compressed so that Meckel's canal is almost obliterated.

The articulation between dentary and splenial in the anterior part of the jaw, and the articular-angular complex at the rear, is essentially a squamous suture, the dentary overlapping the surangular and angular laterally and the splenial at least clasping the ventral point of the angular medially. A notch is sometimes present in the upper border of the dentary to clasp the anterior end of the surangular. The prearticular lies ahead of the articular cotylus and behind the splenial, medial to the surangular, and is variously developed; in loons it extends far forward so that its anteroventral border closely follows the posterodorsal edge of the splenial without actually forming a suture with it. More generally the prearticular is reduced and may not approach the splenial closely. As in archosaurs, the splenial is confined to the medial surface of the jaw.

The external mandibular foramina are variable in development and may lie either along the suture between the dentary, angular, and surangular, as in the crocodile, or entirely within the surangular; both openings are present in some, but many birds have lost these foramina completely.

A further character for distinguishing the jaws of birds and reptiles is the shape of the articular facet. In birds this tends to be double, or at least to include a ridge separating the two cotyli for the double condyle of the quadrate. In reptiles it generally is a

single transverse cylindrical surface, although in genera with pronounced propalinal jaw movements, such as *Sphenodon* and *Diadectes*, it may have an anteroposterior median ridge on its surface. These exceptions bear no resemblance to the double cotylus of birds.

In summary, the available criteria appear to be:

Archosaurian Reptile	Bird
1. Rami suturally united.	1. Rami with fused symphysis.
2. Coronoid bone present.	2. No ossified coronoid.
3. Sutures tend to remain visible.	3. Considerable fusion of jaw elements.
4. Meckel's canal open.	4. Meckel's canal obliterated.
5. Mandibular foramen well developed.	5. Mandibular foramen small or absent.
6. Cotylus simple, transverse.	6. Cotylus double, often oblique.

Exceptions to most of these points may be found; for example, the symphysis is fused in predentate dinosaurs. But confusion is not likely from these; in any case they do not apply to the *Ichthyornis* problem.

Neither of these sets of criteria is satisfied by the "*Ichthyornis*" jaw. Reptilian affinities are seen in the fairly open sutures, but not all of these are discernible. The indication of a separate coronoid bone is more significant. Meckel's canal is fairly well developed. The simple form of the articular cotylus is reptilian. But the jaw differs markedly from those of archosaurs in the absence of a mandibular foramen and of any trace of symphysis of the jaws. Moreover, the relation of the angular and prearticular are unlike those of either birds or archosaurs, in both of which the angular forms the retroarticular process and the prearticular is anterior to the quadrate cotylus.

The "*Ichthyornis*" jaw lacks any of the features which distinguish birds from archosaurian reptiles, and also differs from both of these in important features which they hold in common. On the basis of mandibular osteology alone, the jaw appears to be neither avian nor proavian.

COMPARISON WITH HESPERORNIS

The validity of the distinctions just made between bird and reptile jaws can be illustrated by examination of the jaws of *Hesperornis*, a large, specialized diving bird of the Upper Cretaceous which retained reptilian teeth.

Hesperornis jaws are indisputably associated with the remainder of the bird skeleton, and show unquestionable avian characteristics in their articular region. At the same time, they are convergent toward those of the mosasaurs in the lack of an intermandibular symphysis and in the presence of a transverse intramandibular joint. A comparison between *Hesperornis* and *Ichthyornis* is thus in order.

Marsh's description (1880:11) of the lower jaws of *Hesperornis* is very brief:

> "The lower jaws are long and slender, and were thickly set with teeth. The rami were united at the symphysis in front only by ligament, a feature unknown in modern adult birds. There is an imperfect articulation between the splenial and angular elements, which probably admitted of some motion; and all the other sutures are open, or distinguishable. There was apparently a mandibular foramen. There is a well marked shallow groove on the outer superior margin of each dentary bone, for the reception of the maxillary teeth, when the jaws were closed. (Plate I, figure 3b). The angle of the mandible extends backward but a short distance beyond the articular face for the quadrate, and the extremity is obliquely truncated."

Except for the allusion to a mandibular foramen, which is shown to be absent by the left jaw of *H. regalis* in Marsh's collection as well as by the excellent specimen of *Hesperornis gracilis* at the University of Kansas, and the characterization of the retro-

articular process as short, the description is essentially correct. Additional details afford a better basis for assessing the relationships of this bird.

As restored by Marsh, the mandible of *H. regalis* was 257 mm. (10 inches) long; that of *H. gracilis* as restored here from the disarticulated specimen in the University of Kansas Museum is 208 mm. (8¼ inches). A check on this reconstruction is provided by measurements (kindly furnished me by Dr. R. W. Wilson) of the skull of that individual, which is intact although somewhat distorted. The distance from the quadrate facet on the squamosal to the tip of the beak, corrected for distortion, is 190 mm., which corresponds well with the length 187 mm. from articular cotylus to the tip of the dentaries on the jaw. Perhaps the dentaries are too short; the material did not permit direct measurement of their length which was inferred by comparison with *H. regalis*.

Articular.—This small element is confined largely to the region of the cotylus, which resembles that of modern birds in its division into anterolateral and posteromedial sections, but is simpler in form. A somewhat oblique, elongate, concave facet for the inner condyle of the quadrate, its lateral end posterior to and higher than the medial end, is separated by a ridge from the lateral facet, which extends onto the surangular bone. A small basin lies just in front of the articular surface. The form of the articulation differs from that of reptiles in its oblique rather than transverse axis and in its tendency to division into two parts. Among modern birds, it most closely resembles that of loons (*Gavia*) in this region, but it differs in the absence of any separation of the posterior cotylar facet into two parts by a deep concavity for the condyle of the quadrate.

Angular.—Sutures are not determinable between the articular and angular. The latter bone presumably forms the retroarticular process. This structure is produced posteriorly far more than in modern birds (aside from the Anseriformes and Galliformes which differ radically from *Hesperornis* in the shape and position of the process). Perhaps its closest approach is to the angle of penguin (Sphenisciformes) jaws, but it exceeds these in length. In form it is more like the Ardeidae than the Gaviidae, but even more drawn out than in that family. The angular process proper is an oblique plate of bone sloping downward and slightly outward to the rear of the articular cotylus; its posterior end is thickened and rounded. It is supported externally by a vertical lamina continuous with the outer wall of the mandible, but displaced to beneath the center of the articular. An interdigitating suture between the surangular and angular on the lateral surface of the mandible just below and in front of the cotylus may be seen on all specimens. The angular continues forward along the lower edge of the mandible, its dorsal border lying medial to the lower edge of the surangular. Its thickened anterior end is rounded and slopes upward and forward at an angle of 40° to 55° with the axis of the jaw, forming an inclined, cylindrical articular surface which matches a corresponding concavity in the splenial.

Surangular.—Neither the left jaw of *H. regalis* (Y. P. M. no. 1206) nor that of *H. gracilis* (K. U. M. V. P., no. 2287) has complete surangulars, although all but the anterior end can be reconstructed from the parts available. It is a deep, thin bone, rounded above and bearing a low coronoid process about midway along its dorsal margin. Ventrally it reaches almost to the bottom of the jaw for part of its length, but forward of this the angular is again well exposed laterally. Its medial surface is somewhat excavated posteriorly below the thickened upper margin and above the descending portion of the angular ahead of the articular cotylus, most noticeably in *H. regalis*, but there clearly is no mandibular foramen. The right jaw of *H. regalis* has an oval perforation at this point, but the edges are rough and it is clearly a post-mortem fracture; there is none to correspond with it on the left jaw of the same specimen. In general form the surangular resembles that of the herons (Ardeidae) and cormorants (Phalacrocoracidae) save that the coronoid process is a bit more anterior than in either of these.

Prearticular.—No remains of this bone have been identified with certainty. However, in the type of *H. regalis* are two thin blades of bone, rounded at one end, whose size would fit well within the surangular to form the interior wall of the mandibular canal. They lie in the matrix above and behind the posterior end of the right mandible and might well be the prearticulars of the dissociated jaws. This bone is evidently the basis for the portion of the prearticular shown in Marsh's plate I, figure 4 (1880). The shape of the rounded end is not unlike the anterior end of the prearticular of *Gavia* or *Ardea*, and in figure 7 it has been restored in analogous position. In recent birds the posterior end of the prearticular is fused to the dorsal edge of the angular; all *Hesperornis* specimens lack a section

of the angular in this region so the relationship cannot be determined. However, evidence is afforded by the rugosity on the inner surface of the surangular about two centimeters in front of the articular cotylus which suggests the contact between surangular and prearticular along the posterior edge of the latter bone. If this is correctly interpreted, the prearticular ascended abruptly from the angular as in *Ardea* or *Phalocrocorax* rather than gradually as in *Gavia*. Its anterior end undoubtedly spanned the intramandibular articulation and was in contact with the dentary and the splenial.

Splenial.—Marsh's figures show the outline of this element correctly; its ventral edge is thickened posteriorly and formed the lower edge of the jaw for some distance anterior to the angular bone. Above this thickened portion the medial lamina rises nearly the full depth of the jaw one centimeter in front of the posterior end and then tapers very gradually downward to the anterior point about two centimeters behind the tip of the dentary. A thin low ridge rises laterally from the base, forming a slight groove for the Meckelian canal. The posterior end of the lower thickened part of the splenial

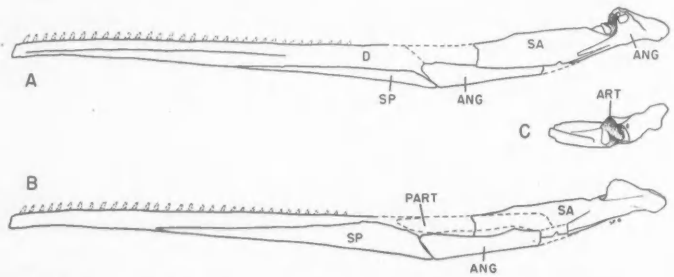


Fig. 7. Reconstruction of lower jaw of *Hesperornis gracilis* Marsh, based on K.U.M.V.P. no. 2287, × ½; A, lateral view, B, medial view, and C, superior view of articular region.

extends far backward, and has a sloping, somewhat rugose, concave upper surface. This formed an inclined transverse hinge with the anterior end of the angular. Presumably this joint was spanned by the prearticular and the posterior lamina of the dentary, which limited the movement on it and also acted as spring leaves to restore the jaw after distortion.

Dentary.—Marsh pointed out the lack of fusion or even of a suture between the two dentaries and also the groove in which teeth were inserted. A lateral groove which he described as for the points of the upper teeth might also be interpreted as analogous to grooves for insertion of the horny beak on the jaws of modern birds. The bone is relatively stout, somewhat deeper behind than in front, and bears a series of mental foramina along a longitudinal groove on the exterior surface. None of the preserved specimens shows its posterior termination, but the left jaw of *H. gracilis* (K. U. M. V. P., no. 2287) becomes extremely thin and deep in the region just anterior to the angular-splenial joint; it is broken off and hence must have projected somewhat farther back, overlapping the surangular.

To summarize, the jaws of *Hesperornis* resemble those of mosasaurs and the "*Ichthyornis*" jaw in the lack of an intermandibular symphysis, the presence of a transverse joint, and the presence of teeth. Here the resemblances stop. The jaw of *Hesperornis* is distinctly avian in its complex articular cotylus, the relations of its angular and prearticular bones, and in the absence of a coronoid bone. Also the form of the angular-splenial articulation is very different from that of mosasaurs and "*Ichthyornis*." Thus the jaw of *Hesperornis* differs from the supposed "*Ichthyornis*" jaw in the very features which set the latter apart from birds and show its affinity to mosasaurs.

FUNCTION OF THE JAWS IN HESPERORNIS

Hesperornis was a large aquatic bird about five feet in length from beak to tail. It shows convergence in structure toward the specialized marine mosasaurs in general

aquatic modifications and in the piscivorous adaptations of its jaws. Details of the convergence have been discussed elsewhere (Gregory, 1952).

Both *Hesperornis* and the mosasaurs are reasonably inferred to have been fish-eaters; their bones are found in a marine limestone which abounds in fossil fish remains, and their sharp, pointed teeth are well suited to catching fish and are comparable to those of other piscivorous animals. The transverse mandibular joint permits outward

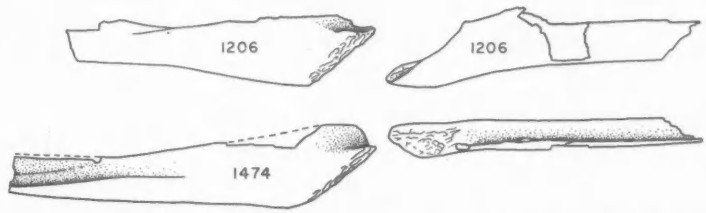


Fig. 8. Intramandibular articulation of *Hesperornis*; left, medial aspect of anterior ends of angulars of Y.P.M. no. 1206 (*H. regalis*) and Y.P.M. no. 1474 (*H. crassipes*); right, medial and superior views of posterior portion of splenial of *H. regalis*; all × 1.

bowing of the jaws to a greater extent than is otherwise possible without dislocation. This device allows the swallowing of much larger prey than would otherwise be possible. It may be noted that the jaws of cormorants have a zone of weakness in the region of the sutures between the anterior (spleniodentary) and posterior (angular-surangular-prearticular) parts of the jaw which permits flexibility in this region.

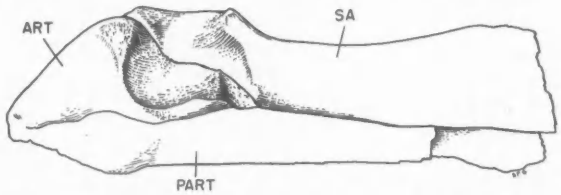


Fig. 9. Dorsomedial view of posterior end of jaw of a mosasaur (*Platycarpus*?) showing simple articular surface, × ½.

Williston (1898:212-213) pointed out a further possible significance to the intramandibular joint of mosasaurs which may well apply equally to *Hesperornis*. Instead of forcing food down the throat by alternate anteroposterior movements of the two mandibles as do snakes, the jaws were pulled backward together by bending outward at the articulation; after the palatal teeth had engaged the prey the jaws both disengaged and sprang forward together for a new hold. The hypothesis of alternate jaw movements, suggested by Cope (1869:216) must be rejected because of the limited possible movement of the quadrate, which is fixed with the pterygoid. Movement of the avian quadrates is likewise limited by the quadratojugal connection, so the same restriction doubtless applies.

Recurved palatal teeth, which are well developed in both snakes and mosasaurs, are an important adjunct to such a feeding mechanism. *Hesperornis* lacks palatal teeth, but the posterior maxillary teeth and recurved tip of the beak would have served the same function of holding the prey while the jaws were being extended.

The similarities of the lower jaws of *Hesperornis* and the mosasaurs are thus seen to be adaptations to swallowing large and slippery prey, specifically fish.

RELATIONSHIPS OF HESPERORNIS

Three principal views have been advanced concerning the relationships of this toothed diving bird. Marsh (1880) considered it a member of a distinct order of primitive toothed birds, related to the flightless ground birds, or ratites; Fürbringer (1888: 1473) accepted the ratite relationship of *Hesperornis* although rejecting the grouping of toothed birds into one order. D'Arcy W. Thompson (1890:14) showed the incorrectness of this view, and considered it an early branch of the same stock as the grebes and loons. Lucas, Stolpe, and other recent students have voiced caution against accepting the aquatic modifications of the skeleton as evidence of affinity, for such characters may arise repeatedly by convergence. The present study, confined to a single portion of the skeleton, cannot hope to solve the problem of relationships. Nevertheless the distinctive features of the jaw of *Hesperornis* which have been described may be said to support the isolated position of *Hesperornis*, which may well have developed its resemblances to the grebes and loons independently.

COMPARISON WITH ARCHAEORNIS

Dames (1884:129) described the lower jaw of the Jurassic bird *Archaeornis* as a long narrow bone with weakly concave ventral border, somewhat higher posteriorly than anteriorly. It has a retroarticular process 4 mm. long. The shattered condition of the specimen renders identification of the irregular hole in the jaw as a mandibular foramen uncertain. Heilmann, however (1927:6), states definitely that there is a vacuity between the surangular and the dentary, although his figure of the specimen fails to show this. A small portion of the splenial is visible on the external surface of the lower edge of the jaw, as in primitive archosaurs and unlike modern birds. Heilmann (1927:5) shows an elongate angular extending to the posterior end of the jaw. The coronoid region is concealed. There is no evidence of a mosasauroid intramandibular joint. This is important evidence that this peculiar structure was not a heritage from reptilian ancestors of birds.

About the only feature in which the "*Ichthyornis*" jaw shows more resemblance to that of *Archaeornis* than to those of modern birds (aside from the presence of teeth) is the lateral exposure of the splenial. But as this itself is a reptilian character, it does not aid in solving the problem of relationships.

COMPARISON WITH MOSASAURS

Throughout the preceeding discussions comparisons have repeatedly been made with mosasaurs. This family of marine lizards is abundantly represented in the Niobrara formation of Kansas. Specimens of *Platycarpus* cf. *coryphaeus* (Cope) have been used for illustration of certain features of mosasaur anatomy, but these features do not vary greatly among the various genera. Because of its slenderness and the large number of teeth, it seems most probable that the "*Ichthyornis*" jaw actually pertains to the genus *Clidastes*.

In all mosasaurs, the angular arises along the lower edge of the rear of the jaw well forward of the retroarticular process, and expands anteriorly. It bears an articular facet for the correspondingly enlarged posteroventral end of the splenial on the lower edge of its anterior end. The form of the articulation is shown in figure 3. The splenial projects slightly behind the dentary and forms the entire ventral edge of the mandible just

anterior to the articulation. The surangular projects slightly forward of the angular, and may in life have had slight contact with the inner edge of the dentary. It is capped by a short coronoid which overhangs the upper edge of the dentary laterally. The prearticular forms the retroarticular process and extends forward on the median wall of the jaw above the joint between angular and splenial and passes between splenial and dentary (see Williston, 1898: pl. 22; also fig. 4).

The "*Ichthyornis*" jaw resembles that of *Clidastes* and other mosasaurs in the following:

1. The presence of a conspicuous articulation between the dentigerous and articular portions of the jaw, and in the exact form and position of the articular surfaces on the angular and splenial bones.

2. The lack of a suture or bony symphysis between the two halves of the jaw anteriorly.

3. The presence of thecodont, recurved, sharp-edged teeth.

4. The position and nature of the coronoid suture on the surangular.

5. The form of the articular cotylus.

6. The posterior prolongation of the prearticular to form the retroarticular process of the jaw and the anterior position of the angular bone.

This combination of characters is known in no other group of animals.

Possible objections to considering the "*Ichthyornis*" jaw that of a young mosasaur include:

1. The obliteration of much of the suture between the splenial and the dentary, which suggests maturity. In far larger mosasaur jaws the sutures all remain open and distinct. Possibly the small size of the specimen may account in part for the obscurity of this suture; other sutures are well defined. Nevertheless one expects all sutures to be visible in newly hatched reptile skeletons.

2. The posterior ends of the splenial and the dentary slope forward at a much smaller angle with the axis of the jaw than in adult mosasaurs. Possibly this is a feature which changes with growth. Although it gives the "*Ichthyornis*" jaw a more bird-like appearance than would otherwise be the case, its significance does not approach that of any one of the mosasauroid resemblances mentioned above.

3. The anterior end of the surangular is embraced between the posterior ends of the splenial and the dentary exactly as in birds. This feature is not found in adult mosasaurs in which the ends of the surangular and the dentary abut against one another in a loose interlocking suture. I am inclined to attribute the difference to growth. The interdigitations at the ends of the dentary and the surangular of a large *Platycarpus* are many times the depth of this interleaving between the elements of the small "*Ichthyornis*" jaw.

In correspondence about this problem, Dr. Hildegarde Howard raised the question of the presence of vertebrae and limb bones of mosasaurs of a size comparable to the "*Ichthyornis*" jaw. To my knowledge no such specimens have been found. Small mosasaur vertebrae, belonging to individuals two feet or less in length, are known; limb and paddle bones are far less abundant than vertebrae or skull fragments in the extensive collections of mosasaurs at Yale; this ratio of occurrence together with the greater probability of collectors overlooking such small specimens in the field might easily account for the lack of such material.

These objections are trivial and in no way modify the conclusion that the jaw is that of a mosasaur and not a bird.

It might be argued that inasmuch as jaws unquestionably associated with *Hesper-*

Table 1

Summary of Differences and Similarities

Ichthyornis	Platycarpus	Alligator	Archaeornis	Hesperornis	Gavia
Coronoid					
Prominent.	Prominent.	Small, internal.	Unknown.	Absent.	Absent.
Articular cotylus					
Single, transverse.	Single, transverse.	Single, transverse.	?	Double, oblique.	Triple, oblique.
Angular					
Confined to ventral edge jaw, tapering to point below art. cotylus.	Confined to ventral edge jaw, tapering to point anterior to art. cotylus.	Large, forming retroarticular process.	Angular elongate, extending to end of retroarticular process.	Angular large, extending back to fuse with articular to form retroarticular process.	Angular large, forming retroarticular process.
Anterior end of angular					
With facet near lower edge to articulate with splenial.	With facet near lower edge to articulate with splenial.	Interdigitating suture between angular and dentary and splenial.	In sutural contact with splenial.	Deep, inclined forward, cylindrical surface for articulation with splenial.	Inserted between dentary and splenial with squamous overlap.
Prearticular					
Large, extending back to form retroarticular process—anteriorly inserted between splenial and dentary.	Large, extending back to form retroarticular process—anteriorly inserted between splenial and dentary.	Small, on inner edge Meckel's fossa.	Unknown.	Apparently like birds.	Arises in front of articular and extends forward to posterior end of splenial.
Splenial					
Visible posteriorly on external edge of jaw where it has small facet for articular.	Visible posteriorly on external edge of jaw where it has small facet for articular.	Confined to interior jaw. Squamous suture with coronoid and prearticular.	Said by Heilmann to have slight external exposure.	Exposed laterally, bearing oblique concave facet for angular.	Confined to interior jaw; squamous overlap of angular, little or none with prearticular.
Anterior ends of dentaries					
Without symphysis.	Without symphysis.	With sutural symphyses.	Symphysis present.	Without symphysis.	Fused anteriorly.
Teeth					
Thecodont (= in sockets)	Thecodont.	Thecodont.	Thecodont.	With swollen bases, in groove.	None.

ornis show indications of an intramandibular articulation, *Ichthyornis* could also have possessed such jaws. Consideration of the following facts, however, will show that this is extremely unlikely.

1. As shown by other portions of their skeletons, *Hesperornis* and *Ichthyornis* are only remotely related, and also were birds of entirely dissimilar adaptations and habits.

2. The intramandibular joint is not part of the common heritage of Mesozoic birds, hence if such a jaw was present in *Ichthyornis*, it must have evolved independently of the jaw of *Hesperornis*.

3. It is most improbable that two birds so dissimilar as *Hesperornis* and *Ichthyornis* would have identical feeding habits and thus evolve functionally similar jaw mechanisms.

4. Even if *Ichthyornis* had developed a jaw mechanism closely similar to *Hesperornis*, it seems beyond probability that it should agree with mosasaurs in those details of jaw structure in which it differs from *Hesperornis* and which distinguish that genus from the mosasaurs.

5. Finally, it must be borne in mind that the "*Ichthyornis*" jaw lacks those features which distinguish the jaws of birds from those of reptiles.

Hence it must be concluded that the lower jaws attributed by Marsh to *Ichthyornis* are in all probability not correctly associated with that bird but represent an extremely small individual of the mosasaur *Clidastes*.

SUMMARY AND CONCLUSIONS

Detailed descriptions and illustrations of the lower jaws attributed to the Cretaceous birds *Hesperornis* and *Ichthyornis* have been given. Important anatomical relations of the jaws of these forms are compared with those of loons (*Gavia*), the earliest known bird (*Archaeornis*), *Alligator* (representing the archosaurian reptiles), and *Platycarpus* (a mosasaur) in table 1.

From these comparisons, *Hesperornis* is found to show remarkable convergence toward the aquatic reptiles known as mosasaurs in the presence of an intramandibular articulation between angular and splenial bones. The details of this articulation are quite different, and *Hesperornis* shows definitely avian characteristics in the morphology of the articular, angular, and coronoid regions of its jaw.

The jaw of *Ichthyornis*, on the contrary, agrees with mosasaurs in minute details of form and relationship of the jaw elements. It lacks every feature by which bird jaws may be distinguished from those of reptiles and differs considerably from the archosaurian prototype from which birds were derived. There is no proof of association with the remainder of the bird skeleton with which the jaw was found, and its occurrence with the bird may easily have been a depositional effect of currents washing objects of the same size together. No quadrate is known in *Ichthyornis* and no contact can be established between the jaw and the remainder of the skull.

Finally, it should be pointed out that the lower jaws attributed to *Ichthyornis* are extremely long and massive in comparison to the rest of the lightly built skeleton of that form. Hawks, owls, and other predatory birds have far shorter beaks in comparison to body size, and have relatively large skulls for birds; but their skull-body ratio is much less than in Marsh's restoration of *Ichthyornis*.

The small fragments of bone containing alveoli which were described as portions of the upper jaw of *Ichthyornis* are quite indeterminate as to what bone was represented as well as what animal.

Therefore, it is concluded that the toothed jaws attributed to *Ichthyornis* are not those of a bird but belong to a small mosasaur.

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Peabody Museum, Yale University, New Haven, Connecticut, July 12, 1951.

AUDITORY RECOGNITION OF PREDATORS

By LOYE MILLER

Through the courtesy of Mrs. Margaret Nice, my attention was called to certain recent literature on the recognition of predators that had escaped my notice. Questions were raised there that prompt me to offer some observations drawn from field experiences in the southwestern United States. Hartley (An Experimental Analysis of Interspecific Recognition, Sympos. Soc. Exp. Biol. No. 4, 1950:313-336) has the following to say about auditory recognition (p. 334):

"The only method of recognition which has been discussed is recognition by visual clues. The possibility that auditory stimuli alone, or in conjunction with visual characters, may be clues to recognition, cannot be discussed.

"André (1904) states that plumage-hunters in Trinidad imitate the hooting of an owl, *Glaucidium phalaenoides*, to attract humming birds . . . within shot. Smith (1946) gave an account of a threat display of a willow warbler, provoked by the imitation of a cuckoo's note; and on one occasion the writer saw an assembly of clamorous mistle thrushes, *Turdus viscivorus*, and blackbirds, *Turdus m. merula* summoned by an imitation of the 'Ke-wik' note of a tawny owl. On the other hand, Nice & Ter Pelwyk (1941) found that a hand-reared song sparrow gave no response to 'excellent imitations of great horned, barred, and barn owls and also the cry of the red-shouldered hawk.'

"The recognition of predators by auditory means is a field for investigation which lies almost wholly unexplored."

Hartley's paper deals with quite extended experiments using stuffed skins or variously painted models of predators placed in the normal habitats of wild birds, and it very strongly supports the thesis that form, texture and color have much to do with predator recognition. The impression is left with the reader that at least some search of the literature had been made to discover published observations on auditory recognition. The scarcity of such records uncovered is most surprising and leads to the suspicion that other field workers, like myself, have taken too much for granted and have failed to record observations, considering them mere matters of common knowledge. Such at least explains my own negligence. A few cases where exact data can be quoted are therefore offered.

REACTIONS TO IMITATED HOOTS OF THE HORNED OWL (BUBO VIRGINIANUS)

Accipiter cooperii. Cooper Hawk. Santa Ana Mountain, 4500 feet, Orange County, California, May, 1938. A male bird came cackling out of forest at second hoot.

Mount Pinos, 6500 feet, Kern County, California, May 30, 1930. A male readily decoyed into close range. On May 31, 1930, I had the same result.

Pajarito Mountains, 4000 feet, Santa Cruz County, Arizona, April, 1945. A bird reacted repeatedly in the course of several days.

Many other cases have been noted for which I have less exact data.

Accipiter gentilis. Goshawk. Sequoia National Park, 7000 feet, California, July, 1928. Three hoots of the Horned Owl brought a Goshawk out of the forest "cackling" excitedly.

Falco mexicanus. Prairie Falcon. Jawbone Canyon, Mojave Desert, California, March 15, 1932. A falcon was flushed from a ledge in the cliff and started out over the open valley. At the sound of the Horned Owl note the hawk circled back and came dashing at me, having located the source of the sound immediately.

Buteo lineatus. Red-shouldered Hawk. Topanga Canyon, Los Angeles County, Cali-

fornia, April 30, 1951. A bird of this species was seen and heard as it circled above the oaks on a hillside where it finally perched. After the second hoot of the Horned Owl, the hawk launched directly toward us but veered off as it sighted us standing in the open.

The large raptors here mentioned are presumably not the prey of the Horned Owl after they have become adult but we found very strong evidence that nearly fledged young of the Zone-tailed Hawk (*Buteo albonotatus*) had been taken from the nest by a Horned Owl (Baboquívari Mountains, Arizona, May, 1945).

Otus flammeolus. Flammulated Owl. Big Pines Playground, Los Angeles County, California, May 10-11, 1934. Horned Owl notes stimulated several of these small owls in various parts of the yellow pine forest.

Chiricahua Mountains, Arizona, 8300 feet, July, 1934. Horned Owl notes roused these owls at three different stations along a stream course. When they fell silent and failed to respond, the call of the Spotted Owl brought them out again at once.

Blue Mountains, Arizona, July 6, 1934. The foregoing experiment was almost exactly duplicated here.

Mount Pinos, Ventura County, California, 7200 feet, July 25, 1936. A bird of this species was located in a small group of conifers by hooting the Spotted Owl's notes. By occasional shifts from Spotted to Horned Owl and back, the little owl was kept stimulated for an hour at a time on three different occasions in the course of two nights.

There is indisputable evidence that the smaller owls are commonly preyed upon by their larger kinsmen. They are therefore alerted by the calls of the larger species.

Cyanocitta stelleri. Steller Jay. Patagonia Mountains, Arizona, 5500 feet, October 10, 1945. These birds were extremely shy and strangely quiet. They could not be approached on the rugged hillside but when I concealed myself carefully and gave the Horned Owl notes repeatedly, they approached very cautiously, slipping silently through the thick growth to very close range. The experiment was thrice repeated in a four-day stay.

Aphelocoma ultramarina. Mexican Jay. Santa Rita Mountains, Arizona, April 27, 1931. Specimens of this jay were sought for some time but the species proved too wary to be approached. Tactics were finally reversed and I sat down under an oak to rest. A few repetitions of Horned Owl notes brought the jays to me and all the desired specimens were collected within fifteen minutes. The experiment was oft repeated in later visits to Arizona mountains, though further specimens were not sought.

Aphelocoma coerulescens. Scrub Jay. For some strange reason the desert races of the Scrub Jay seem much more shy than the representatives from coastal California. Only by resort to notes of the Horned Owl have I been able to obtain needed specimens. Among many experiments, may be noted the following:

Near Oracle, 3500 feet, Arizona, October 13 and 14, 1945. During a three-day stay jays were brought within range only by careful concealment and repeated hooting.

Joshua Tree National Monument, 4000 feet, California, December 5, 1946, and February 12, 1947. The behavior of Scrub Jays was practically identical with that noted at Oracle, Arizona.

Experiments with Scrub Jaws were performed in the non-breeding season. In no instance did the birds assume the mobbing attitude but approach was always silent.

Calocitta formosa and *Cissilopha beecheii*. Magpie Jay and Beechey Jay. Near Alamos, Sonora, Mexico, February 21, 1946. Both these species of jays were found in low thorn forest which was bare of foliage at that season. Their behavior was almost identical with that of Scrub Jays. The experiment with Horned Owl notes was twice repeated with the Beechey Jay.

Pica nuttallii. Yellow-billed Magpie. Near Santa Maria, Santa Barbara County, California, January 4, 1926. In a perfectly silent open oak woods about 10:30 a.m.

a single hoot of the Horned Owl brought prompt response by the Magpies who gave their characteristic excitement notes.

Colaptes chrysoides and *Colaptes cafer*. Gilded Flicker and Red-shafted Flicker. Alamo Crossing, Bill Williams River, Arizona, September 26, 1945. Both species were repeatedly called into close quarters by the use of Horned Owl notes. Similar results were obtained at Alamos, Sonora, Mexico, on February 26, 1946.

All the preceding non-predatory species are large enough to serve as prey for the Horned Owl. Small passerine species have not, in my experience, shown any concern during these tests even when the owls themselves have been attracted and have been very active in broad daylight, seemingly searching for a rival owl which they could not recognize in the human experimenter. The small birds such as juncos, chickadees, warblers, and wrens are too small to serve commonly as prey for the Horned Owl and they showed no reaction whatever.

While the Horned Owl is predominantly a nocturnal species in the latitude of the southern United States, I have known it on a few occasions to be spontaneously active at 10:00 a.m. and at 3:00 p.m. and it is easily roused into responsive hooting at practically any daylight hour.

RESPONSES TO IMITATED NOTES OF SCREECH OWLS (OTUS ASIO)

The Screech Owl is seemingly more strictly nocturnal than the Horned Owl and only two species of smaller birds are recorded in my notes as reacting to its calls with any degree of consistency, the Cardinal and the Phainopepla.

At Alamo Crossing, Bill Williams River, Arizona, on September 26, 1945, Cardinals proved extremely secretive. They were, however, responsive to notes of the Screech Owl in the course of three days we spent there. Phainopeplas reacted more quickly than the Cardinals. The experiment was equally successful with Phainopeplas near Quartzite and forty miles north of Yuma along the Quartzite road in a mesquite-palo verde association at various seasons.

RESPONSE TO IMITATED NOTES OF THE PIGMY OWL (GLAUCIDIUM GNOMA)

This small but extremely vigorous owl is almost entirely a daylight hunter. Furthermore its food consists of the lesser passerine birds to a very great degree. It sounds its metronomic hoot at all hours of daylight but it is difficult to arouse later than the twilight period. It is to be expected then that imitation of its note would prove very effective in arousing small birds to excitement if one is working in the life-zones which it frequents, namely low Transition to Canadian. Such proves very definitely to be the case. A perfectly silent pine-oak forest may be enlivened quickly by patient repetition of the Pigmy Owl's notes.

Mt. Pinos, 6500 feet, Kern County, California, May 30, 1930. Pigmy Owl notes brought a host of scolding birds into a group of black oak trees. There were included nine Mountain Chickadees, two House Wrens, one Solitary Vireo, and two nuthatches.

Frazier Mountain, 6000 feet, Los Angeles County, California, July 8, 1946. Nine species of small birds were attracted within ten minutes.

Saragossa Spring, 7000 feet, San Bernardino County, California, June 25, 1930. Pigmy Owl notes brought one or more individuals of each of the following species: Mountain Chickadee, Oregon Junco, Audubon Warbler, White-breasted Nuthatch, Cassin Finch, Western Wood Pewee, and Pigmy Nuthatch.

Santa Ana Mountains, 5000 feet, Orange County, California, October 8, 1937. Imitation of Pigmy Owl notes brought eight species to excited activity where the woods had been silent before.

Additional and comparable experiences might be recounted by most western bird students.

DISCUSSION

I would emphasize the fact that these experiments were not conducted under laboratory conditions and therefore could not be restricted to the stimulating of one species at a time. That is, group reaction was not ruled out. On the other hand, there was the great advantage of having almost completely natural and therefore normal conditions. There was no element of artificiality other than the imitated sound. It might be said that these imitations were sufficiently accurate to deceive the owls themselves and upon occasion even the critical ornithologist. Completely free, wild birds in their natural habitat are thought then to have reacted in a completely normal fashion.

The responses might properly be classed as either primary or secondary—primary being the response directly to the predator's note and secondary, a response by contagion so to speak. The general hubbub of chickadees, juncos, and warblers was probably the factor that excited a robin, a species too large to be preyed on by the Pigmy Owl. Furthermore there seems to be an instinctive reaction by most animals to certain tone qualities in sounds that are entirely new to their experience. A half grown, albino pet rabbit which had the run of my office was immediately alerted when I imitated the alarm note of a chipmunk. At the second rendition of the sound, "Peter" scuttered to safety under a book case. He had responded to a note entirely new to his individual or his racial experience.

The owl notes employed are round and mellow notes with no distress quality whatever in them. Hence the response of prey species is held to be a primary reaction due to recognition of a predator. Small birds are not therefore stimulated by the Horned Owl note. Nor are they stimulated by Pigmy Owl notes when they are resident species in localities outside the range of that owl, except possibly through curiosity regarding a monotonous and long repeated sound.

The ready response of many owls to imitation of their own notes is presumed to be a territorial reaction toward a supposed rival invader. It therefore has no place in a discussion of predator recognition by sound.

Synopsis and deductions.—

1. Experiments were performed in the field by imitation of the calls of owls of the genera *Bubo, Strix, Otus,* and *Glaucidium.*

2. These imitations were sufficiently accurate to invoke reactions that were presumably normal.

3. Large owls invoke reactions in a species large enough to be endangered at one or another stage in its life history.

4. Small species did not react to large owls either by sight or by sound. They readily react to a small species of owl, however.

5. A species resident in an area outside the native area of the owl seldom reacts to its note.

6. Reactions may be either direct or else indirect by contagion.

7. Certain tone qualities may, in themselves, be exciting. These qualities are lacking in the owl notes employed.

8. The locus from which sound emanates is quickly determined by birds.

9. Curiosity may be a small factor entering into the experiment when the sound is repeated for a long period of time.

10. The ear is of great importance in predator recognition by birds.

Museum of Vertebrate Zoology, Berkeley, California, May 20, 1951.

LIFE HISTORY OF THE CHESTNUT-TAILED AUTOMOLUS

By ALEXANDER F. SKUTCH

The ovenbirds (Furnariidae) comprise a large family of small or middle-sized passeriform birds consisting of well over 200 species, all of which are restricted to continental areas of the Americas. The group is best represented in South America, and particularly in its more southerly portions; numerous species occur in the south temperate regions of Argentina and Brazil. Relatively few are found north of the Isthmus of Panamá and not one reaches the United States. Of all the avian families of the Western Hemisphere, this is perhaps the most heterogeneous in external form, habits, and nidification. Perhaps the greatest uniformity among its multitudinous species is in plumage, brown in many shades and tones being the prevalent color. However, gray and slate-color are prominent in some genera, and in many species bright chestnut, rufous, or cinnamon relieve the duller hues. Although this family occupies an important position in the Neotropical avifauna, we know little about its mode of reproduction. The concealment of the eggs in burrows, cavities in trees, or elaborate closed nests of clay, sticks or other materials, the virtual impossibility of distinguishing the sexes by either appearance or voice and the retiring habits of most species all combine to make the study of nest life a difficult undertaking. Our best single source of information on the nesting of the ovenbirds is W. H. Hudson's "Birds of La Plata" (1920). But Hudson's delightful accounts, based upon observations made in Argentina nearly a century ago, fail to throw light on many points which we expect to find treated in modern life-history studies. Some years ago I published a short account of the life history of the Rufous-breasted Castlebuilder (*Synallaxis erythrothorax*) of northern Central America (Skutch, 1947). The present paper is a small contribution toward filling the tremendous gap in our knowledge of this fascinating group of birds.

APPEARANCE, HABITS, AND FOOD

Like so many members of the ovenbird family, the Chestnut-tailed Automolus (*Automolus ochrolaemus*) is clad in shades of brown, with no bright spectral colors to facilitate its recognition in the dim light of the tropical forest. The dorsal plumage of this rather large ovenbird is dark olive-brown, brightening to chestnut on rump and tail, and to russet-brown on the wings. Its ventral plumage is buffy-brown, paling to creamy-buff on the throat, the feathers of which are somewhat puffed out and conspicuous. There are indistinct light streaks on the chest. The blackish bill is moderately long and fairly stout. The sexes are alike in appearance. The species ranges from southern México to northern Bolivia, Brazil, and the Guianas, and many geographic races are recognized. The present study was made within the range ascribed to the race *exsertus*. In Central America the species is found throughout the Caribbean lowlands, and on the Pacific side from the Gulf of Nicoya, Costa Rica, southward. Here it extends to elevations at least 3500 feet above sea-level.

In the basin of El General on the Pacific side of southern Costa Rica, where my observations were made, the Chestnut-tailed Automolus is a fairly common bird of the heavy forests. Although numerous, it is shy, remains well concealed by the foliage, and is not easy to watch. One must become familiar with its voice in order to realize how abundant it is. Its most usual call is a loud, harsh, slow, long-continued rattle. This is uttered incessantly in the early dawn, when the birds first awaken, and again as the shades of night begin to fill the forest. Strong and far-carrying, sounding from every side, this call proclaims the presence of the bird in fair numbers. During the hours of

full daylight it is only infrequently voiced. The members of a pair keep in contact with each other by means of much lower, throaty notes. So far as I can discover from observation of birds so skillful in remaining concealed, the automoluses roam through the forest in pairs. Often they are in company with other small birds of the lower stories of the woodland, including antbirds, ant-tanagers and, at higher elevations, Stripe-crowned Warblers (*Basileuterus culicivorus*).

The automoluses hunt their food chiefly among curled or clustered dead leaves, sometimes those lodged in the undergrowth near the ground, sometimes those caught among the vine-tangles or the boughs of taller trees well up in the air, but apparently never in the high canopy of the forest. They are adept at clinging in an inverted position, or in any other orientation the situation may require, while they assiduously probe the folds of the leaves with their strong bills. The dead foliage of the prostrate crown of a great fallen tree is a fertile hunting ground for them. When disturbed by man, they sidle up ascending branches with frequent about-faces, nervously twitching their bright reddish-brown wings and voicing their harsh notes, then promptly dart away and vanish amid the underwood.

One day while I sat in a blind amid the forest, watching an antbird's nest, an automolus foraged in front of me. It investigated the concavities of the curled brown leaves of a small dead tree, sometimes hanging head downward to reach them. Evidently in the course of this search an insect fell from a leaf to the ground, for the bird dropped down and hopped about on the ground-litter, flicking the leaves aside with its bill in the manner of an Ovenbird (*Seiurus aurocapillus*) or an ant-thrush. So far as I could tell, it was unsuccessful in retrieving the refugee, and soon ascended, climbing sideways up the slender trunk, to continue to hunt insects and spiders among the coiled leaves hanging on the tree. From time to time it voiced its loud rattle.

Like many forest birds, the automolus may venture forth into thickets or shady plantations at no great distance from the forest edge, making these short excursions chiefly in the dim light of early morning or after sunset, or in gloomy weather. Some years ago, I used to see one or two of these birds, especially at eventide, in a small banama plantation adjoining the forest. Here they hunted among the brown, dry leaves which thickly draped the trunks of the neglected banana plants. As they investigated the long, curling segments of the wind-torn foliage, they usually clung sideways to the thick midribs, nervously twitching their wings, and again and again repeating their loud, harsh notes. Restless creatures, they never lingered long in one spot.

THE NEST

In fifteen years among the forests where the Chestnut-tailed Automolus dwells, I have found only three of its nests, all in burrows in the earth. On the morning of March 26, 1939, while loitering along the Quebrada de las Vueltas in the valley of El General, a brown bird chanced to catch my eye as it flew out from the bank. Going to examine the part of the bank whence it seemed to come, I discovered a straight burrow, 26 inches long, the mouth of which was screened and rendered inconspicuous by the foliage of a slender creeper hanging before it. Even then there was no sign of the tunnel's having been freshly dug, and neither eggs nor material for fashioning a nest were to be seen within it. The nearly vertical clay bank was at this point 40 inches high, and the burrow was situated near its top. The stream which washed its foot flowed sluggishly along a narrow and extremely tortuous channel, bordered on one side by a high, fairly open thicket, on the other, beyond a fringing tangle of bushes and vines, by a small coffee plantation, shaded by trees of mango and *Inga*. But after passing the next sharp bend,

at no great distance from the burrow, the stream flowed along the base of a hillside covered with primary forest.

In the following days, I made repeated visits to this burrow, for I surmised that the still unidentified brown bird would nest in it. A few slender, brown bits of vegetation, apparently petioles, were deposited near the inner end of the tunnel; but since their number did not seem to increase, and I never again saw the brown bird near the burrow, I little by little lost interest in it, and for a week or more neglected to visit it.

When next I looked into the burrow, illuminating its interior by means of a small bulb connected by wire with the socket on an electric torch, I found that a nest was taking form at its inner end. The material of the nest, so far as I could distinguish with a small mirror tied to the end of a slender twig and pushed into the tunnel, was all of one kind: very slender, somewhat curved brown pieces several inches long, apparently petioles or rachises from which the leaf-blades had fallen. Three years earlier I had caused the desertion of a burrow such as this by attempting to watch from a blind while the owners built their nest. Accordingly I resolved not to try to watch the completion of this nest, nor to make a serious effort to see and identify the birds until after the eggs had been laid. The first of these did not appear until April 20, 25 days after I had seen the bird fly from the bank.

The second nest was discovered seven years later, on my farm in El General. Some years before this a shallow pit had been dug into the foot of a steep slope. The burrow was excavated in the low, nearly vertical wall at the back of the pit, which was now choked with weeds and low bushes. The steep hillside to the rear of the pit was covered with tall second-growth woods, which at no great distance merged into primary forest. In front of the pit was a clean, shady pasture, whence later I watched the nesting activities of these forest birds. When found on April 13, 1946, the burrow was 18 inches long; and a nest, placed a little forward of its inner end, was already well begun.

My third nest of the automolus was in a steep slope in heavy forest not far from the site of the second. Here poachers had dug into a burrow of a tepiscuinte or paca (*Cuniculus*), leaving a deep, narrow pit, in whose vertical side the tunnel of the automolus had been excavated. The narrowness of the pit, combined with the curvature of the tunnel, made it difficult to see the contents of the latter; but with electric light and mirror I managed to glimpse part of one white egg. The unfavorable situation discouraged further studies at this nest.

In all three of these burrows, the nests themselves were broad, shallow cups, composed almost exclusively of the slender, curving, secondary rachises of the twice-pinnate, acacia-like leaves of a thorny liana (*Mimosa myriadena*) that scrambles high into the tree-tops. These rachises, from which the many pairs of tiny leaflets had fallen, were brown and dry, covered with a fine pubescence, and armed with tiny retrorse spines on their basal half. They measured from 1½ to 3½ inches in length. The nests were not sufficiently cohesive to be removed from the burrow in their original form. When no longer used by the birds, they were pulled out as a loose handful of the fine brown rachises.

These are the only nests of the Chestnut-tailed Automolus which I have seen. Van Tyne (1926:546) described a nest of another race of the same species (*A. o. pallidigularis*) found on Barro Colorado Island in the Canal Zone. It was situated at the end of a horizontal tunnel, over two feet long, in a perpendicular cut-bank beside a small stream flowing through heavy forest. The bulky, shallow structure was composed almost entirely of a single kind of slender leaf-stalk about ten centimeters in length. In Brazil, Euler (1867:399) found two nests of the White-eyed Automolus (*A. leucophthalmus*),

likewise built in burrows beside streams in heavy forest. They were composed wholly of the fine inflorescence stalks of some plant of the verbena family, interlaced to form a compact fabric. One of the nests, built in a burrow which sloped outward at an angle of 45 degrees, was made twice as thick at the front as at the rear, thereby giving the cup a horizontal position.

THE EGGS

At the nest found in 1939, the first egg was laid between April 18 and 20. The second was present on April 21. Fearful of causing desertion, I did not revisit the nest until April 25, when three eggs were present, forming the full set. Although my nest of 1946 was nearing completion, if not actually finished, when discovered on April 13, the first egg was not laid until April 26, the second two days later. In this nest two eggs formed the full set. My third nest contained at least one egg on April 9, 1947. Thus April appears to be the chief month for laying in the basin of El General, at about 2500 feet above sea-level. The eggs, as seen in the mirror, were pure white and unmarked. To avoid putting further studies of nest life in jeopardy, no attempt was made to remove them from the burrows for measurement. Euler's nest of the White-eyed Automolus contained three white eggs of oval form, almost equally blunt on the two ends.

INCUBATION

In an effort to discover the pattern of incubation, I devoted nearly 12 hours to watching the first burrow and nearly 18 to the second, all the while hidden in a blind. Seldom have I watched so long before the nest of an incubating bird and learned so little about its habits, or been so bored. I saw exceedingly little of the birds I studied. The record made at the second burrow on May 6 and 7, 1946, after incubation had presumably been going on for eight or nine days, is short enough to be given in full:

May 6, 12:30 p.m. I enter the blind; bright sun, clouding over. Shower falls at 2 p.m.
2:48. An automolus suddenly leaves the burrow, flying out across the edge of the pasture.
4:11. An automolus arrives through the thicket behind the burrow and silently enters.
6:05. I leave the bird in the burrow in the failing light. Rain fell hard during the late afternoon.
May 7, 5:10 a.m. I resume watch at dawn.
5:21. An automolus leaves the burrow, flies silently out over edge of pasture.
5:53. An automolus enters, voicing only a few low notes.
6:55. The mate arrives with bill full of material (rachises of mimosa?), clings to vertical stem of sapling in front of the burrow. The one which has been incubating darts out and away. The new arrival is alarmed when I too suddenly raise my field glasses to the window of the blind. It retreats into the bushes behind the burrow and skulks there for 25 minutes, moving around mostly out of my sight and constantly voicing rattling notes.
7:20. At length this bird enters the burrow.
8:23. It darts out and away.
9:37. A bird silently enters the burrow.
11:35. It darts out and away. I go.

During my long vigil I had proved, by seeing one member of the pair come to replace the other at 6:55 a.m., that both male and female share the task of incubation; but I could not distinguish the sexes nor learn how they divided the day between them, nor which sat through the night. On the afternoon of May 6, I timed one long session on the eggs lasting more than 138 minutes, and next morning three sessions lasting 62, 88 and 118 minutes, respectively. Morning and afternoon, the eggs had been left unattended for three periods of 83, 32 and 74 minutes' duration. Such periods of neglect appear to be typical of the ovenbirds; I have found them at nests of the Guatemalan

Leaf-tosser (*Sclerurus guatemalensis*), Minute Xenops (*Xenops minutus*), and two species of *Synallaxis,* in all of which the two sexes together fail by a good deal to keep the eggs constantly covered, although those that I watched did better than the automolus. The bringing of material to the nest during the course of incubation (as at 6:55 on May 7) is also characteristic of the family, as of other birds which build very bulky or loosely constructed nests.

A week later, on May 15, I again devoted a morning to watching this burrow. I thought that perhaps the automoluses would incubate more constantly now that their eggs were almost ready to hatch, but the contrary was true. The member of the pair that spent the night in the burrow darted out and away at 5:39 a.m., leaving the eggs uncovered until 6:14, a period of 35 minutes. Then this bird or its mate came and sat for 89 minutes, or until 7:43. At this hour an automolus approached through the thicket and darted into the burrow, and almost at once one shot out and away. Although I could not actually see the change-over at the nest far back in the burrow, I believe it a fair assumption that the individual who entered was not the one that came out so promptly, and that an exchange of duty did actually occur. The newcomer sat for 86 minutes, as though it felt obligated to incubate just as long as its mate had done, but no more. It flew away at 9:09, and then for 2 hours and 2 minutes, or until 11:11, the nest was left unattended. I was in front of the burrow, looking in to assure myself that one of the pair had not slipped in unnoticed by me, when the automolus which at last had remembered its eggs darted out of the thicket and almost bumped into me.

To summarize: In 18 hours of watching at this nest, I timed six diurnal sessions on the eggs, ranging from 62 to 138+ minutes in length (this longest was begun before I started to watch) and averaging 96.8 minutes. There were five periods of neglect ranging from 32 to 122 minutes, averaging 69.2 minutes. Computing by these averages, the eggs were incubated only 58 per cent of the time. The birds always approached the burrow through the thicket behind it; they invariably left flying rapidly and low over the edge of the clean pasture in front to enter a stand of tall second-growth woodland to the south.

At the nest beside the Quebrada de las Vueltas in 1939, I failed during 12 hours of watching to witness a single change-over on the eggs; but later I saw that both sexes brooded the nestlings, so without much doubt they both incubated the eggs. I timed four sessions, two not in their entirety, lasting 78, 183+, 124+ and 72 minutes. There were two periods of neglect, of 64 and 52 minutes' duration. Thus this pair kept the eggs covered more constantly than the second pair. They approached through the thicket behind the bank, and on leaving flew down the river.

At the burrow watched earlier, the parents always flew out before I could approach and look in. Probably this was because, to reach the mouth of the tunnel, I had to jump or slide down the river-bank close by, and the noise or vibration warned the automolus of my approach. The bird in charge of the eggs would move forward to the mouth of the tunnel, remain there for a few moments with head and shoulders projecting but screened by the foliage of the creeper that draped over the edge of the bank, then dart rapidly and silently across the stream and away. At the second burrow, when I began daily visits of inspection to time the hatching of the eggs, I sometimes surprised a parent inside when I threw in the beam of the electric torch. Hearing my approach, it had apparently moved slowly and reluctantly toward the entrance to look out and see what was happening. When the beam of light fell into its face, it would retreat to the end of the burrow behind the nest and remain there. Then no moderate amount of stamping on the ground a few yards away would send it into the open.

At the first nest, the three eggs hatched on May 12. Because of the uncertainty as

to the date of laying the third egg, it is not possible to give an exact incubation period. The second egg had been laid on April 21 and if, as seems likely, the third followed after an interval of two days, or on April 23, the incubation period was 19 days; but it may have been a day more or less. At the nest studied in 1946, the two eggs had not hatched 20 days after the set was complete. When I returned the following day, fully expecting to see the nestlings, the nest was empty, probably having been raided by a snake! For small birds, ovenbirds have long incubation periods. That of the Guatemalan Leaf-tosser was, in one instance, at least 21 days. In *Synallaxis* the period is 17 or 18 days.

THE NESTLINGS

The newly hatched automoluses in the first burrow had pink skin, with sparse gray down of the usual passerine type, and tightly closed eyes. The empty shells were promptly removed from the nest, whether swallowed by the parents or carried out in their bills I do not know. On the morning when the nestlings were two days old I watched their burrow for three hours. I had not long to wait to learn that both parents attended them. Between 5:30 and 8:30 a.m. they jointly fed the nestlings nine times. This was only three feedings for each little one, assuming that only one was fed on a visit and that all received equal shares. But the articles brought were big for such small nestlings. The food served to them seemed to consist wholly of adult insects, of which I did not recognize the kinds, and larvae. Both parents warmed the nestlings, and thrice I saw one, arriving with food, remain in the burrow after the departure of the mate, who had been brooding. In the three hours, the nestlings were brooded eight times, for periods ranging from 2 to 17 minutes, a total of 75 minutes. Usually a parent did not continue to cover the nestlings until the mate arrived, but after an interval of brooding flew away, leaving them unattended. At dawn the parents rattled loudly as they approached the nest, but soon they came and went in silence.

The parents ceased to brood, even during the night, when the nestlings were only ten days old and covered merely by their sparse natal down and sprouting pin-feathers, from which the plumage had not begun to escape. I was surprised that nestlings so naked should be left uncovered during the night. I visited them again at daybreak on the following morning to confirm my observation, and again found them alone. Apparently they remained sufficiently warm in the burrow without a parent to cover them.

Each morning, when I peeped into the burrow at dawn, I saw a row of five or six, pure white, round, little objects lined up on the rim of the nest, at the front. These were the droppings of the nestlings, which during the early morning the parents carried off, one each time they visited the burrow with food, until all the waste matter had been removed.

To learn something of the nature of the food given older nestlings, I watched the burrow for a total of four hours on the mornings of May 24 and 25, when the young automoluses were 12 and 13 days old. At first I sat in the blind; but the parents coming with food flew so rapidly and directly into the burrow that I could not distinguish what they carried in their bills. Finally I took down the blind and sat openly on the shore of the river opposite the burrow. My presence there caused the parents to hesitate and waver; but they would eventually enter the nest despite their mistrust, and this delay gave me time to recognize what they carried.

From 5:35 to 8:35 on May 24, the parents brought food 12 times. The following morning they brought food five times between 5:45 and 6:45. Among the items recognized were insects, some of them very big, caterpillars (one hairy), four small lizards, and a big black spider. Van Tyne (*loc. cit.*) saw the parents bring small lizards to the

young in the nest he watched on Barro Colorado Island. The food of these nestlings resembled that of the related Streaked Tree-hunter (*Thripadectes rufobrunneus*) of the highlands. I did not see the Chestnut-tailed Automolus bring any frogs, which figure so prominently in the diet of their highland relatives, but possibly longer watching would have revealed that these, too, form part of their food.

When the nestlings heard the voice of an approaching parent, they set up a loud, clear, little chiming of their united voices, which was continued after the attendant entered the burrow. Or, if the parent approached in silence, the chorus did not begin until after the adult had flown into the tunnel. By throwing a beam of light into the burrow and clucking with my tongue, I could cause the nestlings to call in the same fashion. As all three faced me with their mouths open, expecting food, I could clearly see that the interior of the mouth was flesh-color, not bright red or orange or yellow as with so many nestlings reared in open nests; and there were no conspicuously projecting, light-colored corners.

When 14 days old these nestlings were nearly feathered. Now for the first time they shrank back in the nest, evincing fear, when I looked into the mouth of the burrow. All three flew away on May 30, when 18 days old, and promptly disappeared from the vicinity. I can not recall ever having seen an automolus attending fledglings in the forest.

SUMMARY

1. The Chestnut-tailed Automolus (*Automolus ochrolaemus*) inhabits lowland rainforest, where it hunts among the underwood and lower levels of the trees. Its food consists of insects, spiders, and lizards, found chiefly among curled or clustered dead leaves hanging from dying boughs or lodged in tangles of vines. The bird investigates these while clinging in the most diverse positions, often with body inverted.

2. The call, a loud, harsh, slow rattle, is uttered very frequently in the morning and evening twilight.

3. The nest is placed in a burrow in the bank of a forest stream or other more or less vertical exposure of the soil. The tunnel is probably dug by the birds themselves, although conclusive evidence for this is lacking. Three burrows ranged from 18 to 26 inches in length.

4. At the inner end of the burrow the birds build a broad, shallow nest, consisting almost wholly of a single kind of vegetable material. In the valley of El General, Costa Rica, the secondary rachises of *Mimosa myriadena* are the preferred material.

5. The pure white eggs, two or three in a set, are laid chiefly in April in El General (elevation 2500 feet).

6. Both parents incubate, each sitting continuously for a period usually longer than one hour and sometimes more than three hours. The sitting bird often flies away before the mate comes to take over the duty of incubation, with the result that the eggs are frequently left uncovered for substantial periods, ranging from half an hour to two hours in length. At one nest the eggs were incubated only 58 per cent of the 18 hours devoted to watching.

7. At one nest the period of incubation was approximately 19 days. At a second nest the eggs had not hatched after 20 days; the next day the nest was found empty.

8. At birth, the nestlings have pink skin and sparse gray down. Both parents brood and feed them, bringing large insects, caterpillars, spiders, and small lizards. They remove all droppings.

9. After the age of ten days the nestlings were no longer brooded even by night. At 14 days they were feathered. They left the burrow when 18 days old and were not seen thereafter.

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SOME OBSERVATIONS ON THE BIRDS OF SOUTHERN KOREA

By CHESTER M. FENNELL

While working for the United States Army in Korea during the years 1947 and 1948, I spent as much of my leisure time as possible in the field observing the bird life of that country. Since the northern half of the country was under Russian control, my activity was necessarily limited to the region south of the 38th parallel. Furthermore, since all types of Korean transportation were "off-limits" and Army vehicles were extremely difficult to procure for other than strictly official purposes, my field trips were again confined, for the most part, to those areas which I was able to reach conveniently and cover on foot. However, the months of January and February, 1948, were an exception, for during that period Colonel L. R. Wolfe, XXIV Corps Quartermaster, and I were able to obtain a recreation jeep nearly every weekend and we covered the region lying within a radius of some twenty miles of the city of Seoul. Although I was without firearms of any sort, Colonel Wolfe often generously collected and gave me certain specimens. Others I purchased, from time to time, in small bird shops and in the South Gate Market in the city of Seoul. The small collection that I was thus able to acquire is now deposited in the Museum of Vertebrate Zoology, Berkeley, California. Species marked with an asterisk in the list which follows are represented by specimens in that institution.

I arrived in Seoul on October 4, 1947, and was stationed in that city until my transfer to Pusan, on the southeastern tip of the peninsula, on March 16, 1948. I remained in Pusan until October 12 of the same year, except for brief visits to Seoul.

Except for the two months of January and February, 1948, as mentioned above, my observations in the Seoul area were restricted to the banks of the Han River immediately south and northwest of the city and to granite ridges and peaks within some ten miles north of the city. Carrion and Jungle crows, the Black Kite, Whooping Swan, Greater Scaup Duck, Mallard, Common Golden-eye, Red-breasted Merganser and White-tailed Sea Eagle were species typical of the former region, whereas the Meadow Bunting, Rufous Turtle Dove, Rock Dove, Great Tit and Ring-necked Pheasant frequented the latter. (Scientific names of each of these birds may be found in the species accounts which follow.) The Yellow-throated Bunting, Slaty-crowned Redstart, Oriental Dusky Thrush, Rufous Turtle Dove, Black-billed Magpie and Eurasian Sparrow Hawk were generally found in small wooded areas around the shrines and public buildings within the city limits. One such typical area lay directly behind the capitol building at the north end of the city.

Observations in the vicinity of Pusan were divided between the waterfront and piers along the North Inner Harbor and low well wooded mountain slopes surrounding a water reservoir approximately five miles north of the city. Species typical of the former area included the Yellow-billed Loon, Black-tailed Gull, Herring Gull, Eurasion Black-headed Gull, Black-billed Magpie, Carrion Crow, Mallard and Greater Scaup Duck. The water reservoir attracted the greatest concentration of bird life that I found at any one place throughout the entire country in both number of species and of individuals. Species of that particular district were: the Chinese Goshawk, Ring-necked Pheasant, Rufous Turtle Dove, White-rumped Swift, Eurasian Kingfisher, Black-capped Kingfisher, Oriental Broad-billed Roller, Pigmy Woodpecker, Red-rumped Swallow, Black-naped Oriole, Eurasian Jay, Brown-eared Bulbul, Short-tailed Bush Warbler, Japanese Paradise Flycatcher, Gray-spotted Flycatcher, Forest Wagtail, Gray Wagtail, and Yellow-throated Bunting.

The Water-cock, Streaked Heron, Eurasian Kingfisher, Gray Heron, Great White

Egret, Migratory Quail, Skylark, Gray Wagtail and Black-billed Magpie were representative of the species to be found in the flat open wheat and rice fields surrounding the small country villages.

The axes and rakes of the woodchoppers had swept clean one after another of the country's mountain ranges and ridges, leaving barren sandy paths and deeply eroded canyons in their wake. Naturally, the avifauna has been profoundly affected by this ruthless destruction and the forest-loving species have had to retire to small groves of pines, cryptomeria, oak and chestnut which have been spared in the immediate vicinities of temples, shrines and Old Kings' Tombs. Even these small sanctuaries were being threatened seriously at the time I was there.

The following is a list of observations made under the conditions and at the locations mentioned above. It is hoped that they may add just a bit more of interest and value to the present rather scanty knowledge of the avifauna of the Korean peninsula. Unless noted otherwise, species order and systematic treatment follow the usage of Austin (1948); vernacular names have been changed in some cases at the suggestion of the editors of the Condor and pertain to the species as a unit, rather than to any particular race or group of races. The observations reported here supplement those of Wolfe (1950) which were made principally in the vicinity of Seoul.

Gavia adamsii. Yellow-billed Loon. Observed only during the month of March, 1948, on salt water near the city of Pusan: six in North Inner Harbor on March 20, one on the 22nd, and two in the channel between the city and Chollyando, a small island directly opposite Pusan, on the 28th. All appeared to be quite fearless and tame, frequenting the areas close to the piers and native-sculled fishing boats apparently in search of cast-off fish. The sharply-pointed whitish bill stood out clearly against the water and was an unmistakable field mark. On March 20 I examined two roughly-handled dirty skins hanging from the top of a stone wall enclosing a Korean home at the water's edge in North Inner Harbor and observed a single dead individual floating on the water.

Puffinus leucomelas. Streaked Shearwater. Three to four hundred were observed from the deck of the U. S. Army ferry Hotei on June 21, 1948, while crossing the Korean Straits from Pusan to Hakata, Japan. The largest concentration was observed just outside Pusan Harbor between 7:30 a.m. and 8:30 a.m. Stragglers were observed at 10:30 and a flock of approximately 100 more was seen at 4:00 p.m. near some small islands just outside the harbor of Hakata. All were flying low over the water, apparently in search of food and heading toward the center of the Straits. On July 4, while returning to Korea from Japan, I again observed a flock of approximately 500 individuals some two hours out of Hakata. Stragglers were seen all the way across the Straits on this trip. However, during another crossing of the Straits on October 12 I failed to see a single individual of this species.

Ardea cinerea. Gray Heron. A single individual was observed along a small stream east of Seoul on March 7, 1948, an early spring arrival date. One was observed in flight high over the downtown section of Seoul on July 16. From four to eight at a time were seen from the windows of a train moving between Seoul and Taejon on March 16, April 9 and September 25, 1948. One to twelve a day were observed in the vicinity of Pusan on April 4, May 5, 23, 30 and 31, August 26 and 29 and September 12 and 25. Twelve were observed from a moving train between Pusan and Taegu on September 25. I failed to locate a single nest in the Pusan area but was told that this species nested near the Zoological Gardens in the city of Seoul.

Butorides striatus. Streaked Heron. Common summer resident in the Pusan area, being observed regularly from May 19 through September 18, 1948, in the vicinity of pine groves, small ponds and flooded rice fields. On May 19 two that were perched in the tops of tall pine trees surrounding a small temple approximately five miles north of Pusan displayed considerable concern because of my presence and, in general, acted as though they might be nesting in the immediate vicinity. Several apparently old nests were located in nearby pines some 45 feet above the ground and excrement whitened the ground below the trees in several spots in the area. Adult birds were observed throughout the summer in this locality although I failed to observe any young birds. Inaccessibility of the nests prevented me from examining the contents.

Bubulcus ibis. Cattle Egret. A single individual was observed on May 5, 1948, in a flooded rice field approximately one mile east of Pusan. It was in the company of two Gray Herons. The reddish tan color on head and neck stood out clearly. Austin (1948:39) lists this species as a straggler in Korea.

Casmerodius albus. Great White Egret. Common summer resident, noted in the Pusan area from March 16 until October 8, 1948. One hundred fifteen were counted from windows of a moving train on September 25 between Pusan and Seoul: 50 between Pusan and Taegu, 10 between Taegu and Taejon and 55 between Taejon and Seoul. On January 4, 1948, Wolfe and I observed a single individual flying high over the Kings' Tombs area approximately 15 miles east of Seoul.

Cygnus cygnus. Whooping Swan. Two were observed on January 11, 1948, resting on a stretch of open water in the Han River approximately one mile west of the Yongdongpo highway bridge near Seoul. They were extremely shy and, upon my approach, swam to the opposite bank of the river where they left the water altogether and stood on the sandy bank. Their nervousness increased as I continued to advance and was expressed by a vigorous bobbing of their heads. Finally, they took off at a splashing run across the surface of the water and launched themselves into the air. The run was approximately 50 feet in length and was accompanied by a fast, frantic flapping of the wings.

**Anser fabalis*. Bean Goose. A single dead female, purchased from a Korean peddler in Seoul on February 22, 1948, was saved as a skin. I never observed this species in the field.

**Casarca ferruginea*. Ruddy Sheldrake. A single dead male purchased in the South Gate Market Place in Seoul on February 1, 1948, was saved as a skin. I never observed this species in the field, although Austin (1948:56) calls it a common winter visitor.

Anas platyrhynchos. Mallard. Observed regularly in large flocks of 80 to 400 on the Han River near Seoul from November 2, 1947, until March 7, 1948. Four observed on the Naktung River near Pusan on April 4, 1948.

Spatula clypeata. Common Shoveller. Small flocks of 11 to 24 observed on a small lake near Pier 3, Pusan, on March 20, 22, and 28, 1948.

Aythya marila. Greater Scaup Duck. Observed in North Inner Harbor, Pusan, in flocks of from 75 to 130 on March 17 and 20, 1948. Forty were seen on the Naktung River some eight miles northwest of Pusan on April 4, 1948.

Bucephala clangula. Common Golden-eye. Common and regular winter visitant in the Seoul area. It was observed on the Han River from January 11 until March 7, 1948, in flocks of from five to 75 individuals, often in the company of large flocks of Mallards. In the North Inner Harbor at Pusan and on the Naktung River small flocks of four to 12 were observed from March 17 until April 4, 1948.

Mergus serrator. Red-breasted Merganser. Common winter visitant in the Seoul area, being observed regularly on the Han River in flocks of 14 to 50 from January 11 until March 7, 1948. They are apparently much more wary than the Mallards with which they are often associated, and seem to prefer the center of the river, rarely frequenting the water near the banks.

Milvus migrans. Black Kite. Common permanent resident in the Seoul area, being seen daily soaring over the city, often frequenting the refuse heaps and even perching on the roofs of the larger downtown buildings. They were often attacked by both the Carrion Crows and magpies. Austin (1948:73) lists only the race *lineatus* for Korea. Strangely enough I failed to observe a single individual of this species in the vicinity of Pusan during the entire seven months of my residence there.

**Accipiter soloensis*. Chinese Goshawk. Common summer resident in the Seoul area, according to Wolfe. The first I observed was a pair perched in the top of a large pine tree in the vicinity of Pusan on May 19, 1948; I had them under observation for more than one-half hour. On July 11 I saw three in flight over the same spot and on July 19 discovered a nest along the shore of a water reservoir some five miles north of Pusan. This nest was located in a medium-sized pine tree approximately 16 feet above the ground and contained three small downy young. When I revisited the nest on August 7, one of the young attempted to fly from the nest and fatally injured itself. I saved the skin which is now no. 117659 in the collection of the Museum of Vertebrate Zoology.

**Accipiter nisus nisosimilis*. Eurasian Sparrow Hawk. The author was with L. R. Wolfe when he collected a single female of this species in a small grove of chestnut and pine trees approximately 20 miles southwest of Seoul on February 23, 1948. Another hawk, tentatively referred to this species, flew over our heads as we were approaching the grove. The author saved as a skin a dead female purchased in the South Gate Market in Seoul on February 29, 1948.

Buteo rufinus. Upland Buzzard. Two observed by L. R. Wolfe and the author soaring high over mountainous country about 16 miles east of Seoul on February 8, 1948. Field markings particularly noted were the rounded tail, white from below with a broad dark terminal band, and the dark under surface of the wings with large whitish patches on the first joints. Presumably this was the form *hemilasius*, the only Korean representative listed by Austin (1948:76).

Buteo buteo. Eurasian Buzzard. One was observed perched on the top of an electric pole some ten miles east of Seoul on January 18, 1948. This species was seen regularly throughout the month of February of the same year in the Seoul area by both Wolfe and myself. Four were observed by the author on April 4, 1948, along the Naktung River near Pusan. These were presumably all of the form *burmanicus*, the only race listed from Korea by Austin (1948:77).

Haliaeetus albicilla. White-tailed Sea Eagle. Observed fairly regularly near Seoul during January and February, 1948, by both Wolfe and myself. It was usually seen resting on the ice- or snow-covered river banks at this season. Two on a snow-covered sand bar in the middle of the Han River on February 1 were within 15 feet of a flock of Mallards which paid not the slightest bit of attention to the eagles. Carrion Crows flying overhead occasionally swooped at them or alighted on the sandbar nearby and indicated what I interpreted as concern vocally and by bowing.

**Falco tinnunculus*. Eurasian Kestrel. A dead female, purchased in Seoul on February 29, 1948, was identified as *F. t. interstinctus* by H. G. Deignan. One was observed in flight over rice fields approximately 15 miles east of Seoul on March 14, 1948.

Coturnix coturnix. Migratory Quail. Two were flushed from a grass-overgrown dike along the edge of a dry rice field approximately three miles southwest of Pusan on April 4, 1948. This was my only observation of the species. Strangely enough I never found it in the South Gate Market Place in Seoul which tends to attest to its scarcity in that area.

**Phasianus colchicus*. Ring-necked Pheasant. Common permanent resident in both the Seoul and Pusan areas. I saw as many as 200 dead birds for sale in the South Gate Market Place in Seoul nearly every time I visited the market during the winter of 1947-48. I was told by a Korean friend that the natives poisoned them by inserting cyanide in whole grains of corn and scattering it in the fields. The mass slaughter must have reaped a heavy toll and yet the species seemed to be making a strong stand. The skin of a single female collected for me by L. R. Wolfe on February 8, 1948, along a small stream about seven miles south of Seoul was identified by H. G. Deignan as *P. c. karpowi*. Cocks were heard calling in the Pusan area between March 28 and September 6, 1948. The height of the courtship season in this area, determined by the frequency of crowing, appeared to be around the latter part of April. Two immature birds, well feathered and approximately half grown, were observed in the Pusan area on August 15, 1948.

Grus sp. Crane. The following observations were all made in the general vicinity of Seoul and are tentatively referred to the White-naped Crane (*G. vipio*), which Austin (1948:101) states is the most abundant wintering crane of Korea. All birds were soaring or flying overhead at a great height which made positive identification wholly out of the question. Thirty-seven were observed along the Han River near Yongdongpo on November 2, 1947; 20 on November 9, 1947, approximately five miles west of Kimpo Air Base; 38 immediately north of the city on November 11; two approximately seven miles south of Seoul on February 15, 1948; and four on February 21, two miles north of Kimpo. On each occasion my attention was first drawn by the sounds of their cries.

Gallicrex cinerea. Water-cock. Observed fairly regularly in the Pusan area between June 5 and August 5, 1948, and often heard calling during the middle of the night.

**Otis tarda dybowskii*. Great Bustard. During the early afternoon of February 21, 1948, Wolfe and I saw a group of three feeding along grass-covered dikes of frozen rice fields about eight miles northwest of Seoul. They were extremely shy and as soon as Colonel Wolfe had taken a few steps in their direction, they rose in flight and settled another several hundred feet distant. Lt. Col. E. J. Teberg of the XXIV Corps Engineer Section in Seoul said that on or about February 7, 1948, he had observed two birds of this species along the Han River some 15 miles east of Seoul. He was successful in shooting one of the birds with a carbine at long range and said that it weighed 25 pounds and proved to be good eating. A female was purchased in Seoul on March 4, 1948, and its stomach was filled with green grass.

Actitis hypoleucos. Common Sandpiper. Observed only in the spring and fall in the Pusan area:

one on May 5, 1948, along a deep, grass-overgrown ditch in a flooded rice field; four on August 29 along a dike of a flooded rice paddy; and one on September 12 along a small stream near railroad tracks.

Capella sp. Snipe. A single bird was observed on September 2, 1948, and two on September 9, in a grassy, swampy area approximately five miles north of Pusan.

Larus crassirostris. Black-tailed Gull. Common along the piers in North Inner Harbor, Pusan, during the latter half of March, 1948, and the first half of September. They were generally seen in flocks of approximately 100, occasionally in the company of the larger Herring Gull. None was observed in the vicinity of Pusan between March 28 and the last week of August.

Larus argentatus. Herring Gull. About 75 birds at Inchon Harbor on November 23, 1947, were flying among the ships and fishing boats, picking up scraps of refuse. Another group of nearly the same number was resting on rocks in the center of a large pond near Pier 3, North Inner Harbor, Pusan, on March 20, 1948.

Larus ridibundus. Eurasian Black-headed Gull. Three were observed along the shore of a large pond near Pier 3, North Inner Harbor, Pusan, on March 20, 1948. Two were still in winter plumage with only dark spots behind the ears while the third had the entire head a dark, grayish-brown in color.

**Columba livia rupestris*. Rock Dove. A group of 14 was observed in flight just below the summit of a high granite peak about ten miles northeast of Seoul on December 7, 1947. A single dead bird was observed for sale in the South Gate Market Place in Seoul on February 4, 1948, and five on February 18. A group of three was observed in the gravel road ahead of the Army vehicle in which I was riding in mountains north of Chinhae, Kyongsang Namdo, on May 23, 1948.

**Streptopelia orientalis orientalis*. Rufous Turtle Dove. Common permanent resident in both the Seoul and Pusan areas. They were often observed in the heart of Seoul, wading around in the shallow water of the canals picking up bits of food. I flushed a flock of 15 from the ground on the grass- and weed-overgrown southeastern slope of Nam-san, a small mountain at the southern end of the city of Seoul, on December 21, 1947. Birds of this species were heard calling in the vicinity of Pusan from April 24 through the middle of September, 1948. Based upon the numbers of calls heard and courtship flights observed it appears that the courtship season was at its height in the Pusan area during late May and early June.

Cuculus canorus. Eurasian Cuckoo. Common summer resident in the vicinity of Pusan from the latter part of May until the first of August. The first one of the season was heard calling from a pine-wooded ridge approximately five miles north of Pusan on May 22, 1948. A total of 19 was heard calling from mountain slopes some four miles northwest of Heundae, Kyongsang Namdo, on May 30. This date apparently marked the height of the courtship period. I often heard a peculiar chicken-like "cackle" voiced soon after a performing bird began its series of regular "cuckoo" calls. Another variation seemed to be a rapid-fire succession of high-pitched "coo-coo-coo-coo-coo" cries generally given apart from the usual series of "cuckoo" calls. Wolfe reported this species as fairly common also during the summer in the Seoul area, although too shy and elusive to collect or even to observe well.

**Otus bakkamoena ussuriensis*. Oriental Screech Owl. I made a skin of a single dead male purchased in Seoul on February 1, 1948. Wolfe collected one on February 28, in a small grove of pines approximately eight miles northwest of Seoul. It flew out of an old Black-billed Magpie nest as Wolfe kicked the base of the tree in which the nest was located. Another dead bird found in the South Gate Market Place on February 29 proved too old and decayed to save as a skin. Concerning usage of the specific name *bakkamoena*, see Deignan (1950:192).

**Asio otus otus*. Long-eared Owl. I purchased a single dead male in the South Gate Market Place in Seoul on February 1, 1948, but never observed the species in the field.

Apus pacificus. White-rumped Swift. A single flock of approximately 100 birds was observed in flight low over a high mountain ridge some six miles north of Pusan on June 6, 1948. The white rump was particularly conspicuous in flight.

Alcedo atthis. Eurasian Kingfisher. Common summer resident along small streams and flooded rice paddies in the vicinity of Pusan from July 11 through September 19, 1948. They were quite tame and fearless, often permitting one to approach to within 15 or 20 feet.

Halcyon pileata. Black-capped Kingfisher. Observed fairly regularly in the vicinity of a water reservoir in the mountains approximately five miles north of Pusan from July 31 through September 19, 1948. The bright red bill, brilliant purplish blue of the upper parts, white collar and white visible

in the wings while in flight are distinctive field marks. One uttered a loud, clear call as it left its perch on a pine branch and flew out over the reservoir on August 1.

Eurystomus orientalis. Oriental Broad-billed Roller. Two were observed in a small grove of pines on September 5, 1948, approximately five miles north of Pusan, and single individuals in the same general region on September 6, 18 and 19. I never observed them "rolling" in flight as mentioned by Cumming (1933:42).

Dendrocopos major. Great Pied Woodpecker. One was observed by Wolfe and the author in the pine forest surrounding the Old Kings' Tombs approximately 15 miles east of Seoul on January 4, 1948. One was collected by Wolfe on January 18 in deciduous woods about ten miles northwest of Seoul. I saw a single bird flying over a wooded, park-like area near the Seoul Zoological Gardens on October 7, 1948.

**Alauda arvensis*. Skylark. This species was common in the Seoul area, January through March, 1948, being seen as a rule in groups of three to 18 feeding on the ground in open cultivated fields. It was observed in the vicinity of Pusan only along the Naktung River on April 4, 11, and May 23. A single female collected for me by Wolfe on January 25, 1948, three miles east of Seoul represents the wintering race *pekinensis*, according to H. G. Deignan.

Hirundo rustica. House Swallow. Common summer resident in the vicinity of Pusan from April 4 until at least October 10, 1948.

Hirundo daurica. Red-rumped Swallow. A flock of approximately 50 birds was observed on August 8, 1948, busily circling and apparently feeding within a grove of insect-infested alders located halfway up a high wooded ridge some five miles north of Pusan. They captured the insects by flying in under the half-eaten foliage of the trees, hovering in one spot as they picked the insects from the leaves and branchlets. They occasionally perched momentarily on the more open bare branches. On September 1, one was observed skimming over the surface of a small pond north of Pusan in company with a group of 15 House Swallows. Two were observed in flight along the Naktung River near Pusan on September 12.

Oriolus chinensis. Black-naped Oriole. Common and regular summer resident in the vicinity of Pusan from May 19 until August 21, 1948. The height of the courtship season, as indicated by vocal activity, appeared to be from the middle of May through the early part of June, although three were still heard in song as late as August 15. Generally they were quite noisy, often interrupting their melodious whistled songs with cat-like mewing calls and pursuing one another from the top of one pine tree to another.

**Corvus corone orientalis*. Carrion Crow. Common throughout the Seoul area, both within the city and in rural districts surrounding the capital, during my entire stay from October 5, 1947, until March 17, 1948. They were often seen in large flocks around the refuse heaps in company with the Jungle Crows or again in large flocks on the frozen rice fields in company with Rooks and Jackdaws. Common, also, throughout the Pusan area during my entire stay in that city from March 18 until early October, 1948.

**Corvus levaillantii mandschuricus*. Jungle Crow. Common throughout the vicinity of Seoul from my arrival in early October, 1947, until February 21, 1948. They were often observed in large flocks of 75 to 100 around the refuse heaps along the Han River in company with Carrion Crows. In the vicinity of Pusan they were observed infrequently and irregularly from April 18 until September 5.

**Corvus frugilegus pastinator*. Rook. A total of ten was observed in open frozen fields in the vicinity of Seoul from January 4 until February 15, 1948, at which time they suddenly increased in numbers and appeared in large flocks with Carrion Crows, Jungle Crows, and Jackdaws. The species was apparently totally absent from the Pusan area during my entire stay there.

Corvus monedula. Jackdaw. Thirty-two were observed on February 21, 1948, in frozen rice fields about eight miles northwest of Seoul in company with a large flock of Carrion Crows, Jungle Crows, and Rooks. Two days later, in the vicinity of Seoul, Wolfe collected a single individual which he said was very thin and emaciated. Jackdaws were never observed in the vicinity of Pusan.

**Pica pica japonica*. Black-billed Magpie. Abundant throughout both the Seoul and Pusan areas and in all the countryside between. I counted a total of 500 nests in trees and on telephone poles and steel electric line towers from one side of a moving train while en route from Pusan to Seoul on April 6, 1948. Even though the nests are quite substantial and perhaps last for several years, this may

help to give some idea of the abundance of the species. Nesting seems to begin very early in the season since L. R. Wolfe and the author observed several individuals carrying sticks from one nest to another on February 8, 1948, within the city limits of Seoul. A nest located in the steel framework of an electric crane on Pier 4, Pusan, contained six eggs on April 20. A fully-feathered young bird out of the nest was observed near Pusan on July 11 being fed by the parent birds.

**Garrulus glandarius brandtii*. Eurasian Jay. Four dead birds were observed on February 29, 1948, hung up for sale in the South Gate Market Place in Seoul. Two were observed in the top of a large fir tree in the park-like grounds surrounding the Seoul Zoological Gardens on October 7, 1948. I observed jays regularly in small numbers on low, well-wooded mountain slopes about a reservoir five miles north of Pusan throughout my stay in that area. They were generally sluggish in action and made little attempt to remain hidden from sight. I am quite convinced that they nested in the vicinity although I was not successful in obtaining any definite proof.

Suthora webbiana. Crow-Tit. A single flock of 40 birds was observed among low underbrush in the Old Kings' Tombs area some 15 miles east of Seoul on January 4, 1948. Crow-Tits were common in flocks of 10 to 40 among low wooded mountains in the vicinity of Pusan from the latter part of July until early October, 1948. However, during April, May, and June, they were seen only in groups of two to four individuals. Two young birds on the wing were observed being fed by adults on August 11, five miles north of Pusan.

Parus major. Great Tit. Abundant throughout both the Seoul and Pusan areas, particularly in pine woods and on low mountain slopes or ridges. On June 5, 1948, I observed a pair carrying food into a small cavity of a pine branch five miles north of Pusan. The nesting hole was located approximately 12 feet above the ground and situated in such a manner that closer scrutiny without the aid of a ladder was impossible. Several caged birds were also seen in small bird shops in the city of Seoul.

**Parus varius*. Varied Tit. A favorite cage bird in the city of Seoul, although I failed to find it in the field in this area. A pair was attracted by "kissing" the back of my hand on a thickly wooded mountain slope five miles north of Pusan on June 6, 1948. Two others were observed in this same general area on October 3 in company with a flock of approximately 40 Long-tailed Tits and Great Tits.

Aegithalos caudatus. Long-tailed Tit. A group of six was observed in pine woods surrounding the Old Kings' Tombs about 12 miles east of Seoul on January 4, 1948. Three were observed on March 14 in company with a small group of Great Tits in the same area. Groups of 5, 25, and 20 were observed in the vicinity of Pusan on March 24, September 6, and October 3. Apparently the Long-tailed Tit does not nest in that area. They are always very active and keep up a constant *tsee-tsee*ing among themselves. The wings make a loud sputtering sound as the bird flies from tree to tree. They were observed foraging anywhere from four to 40 feet above the ground in low underbrush and high trees.

Sitta europaea. Eurasian Nuthatch. A single bird was seen on the main trunk of a large decayed chestnut tree in the park-like area surrounding the Seoul Zoological Gardens on October 7, 1948. I never observed this species in the vicinity of Pusan.

Microscelis amaurotis. Brown-eared Bulbul. Common in low, well-wooded mountains five miles north of Pusan throughout the entire period of my stay in that area. They were always very noisy, flying from one tree to another, screaming their cat-like calls. On July 24 I observed a pair attacking a Japanese Buzzard in flight, while on August 8 one was noted similarly attacking a Black-billed Magpie on the wing. Upon two separate occasions I have seen this species snatching insects out of the air in typical flycatcher fashion, although I must admit they appeared quite inept and clumsy during the attempt. On October 7, 1948, I observed four bulbuls greedily feeding upon the black berries of an osier-like tree in the wooded park-like grounds surrounding the Seoul Zoological Gardens. Austin (1948:199) calls it "a not uncommon winter visitor to the southern half of Korea, from Kyonggi Do southward" although I found it regularly and common in the Pusan area from March through early October, 1948.

Troglodytes troglodytes. Holarctic Wren. One was observed among low underbrush in the vicinity of the Old Kings' Tombs some 12 miles east of Seoul on January 4, 1948. A total of six was observed upon two different occasions, March 21 and 28, 1948, along small streams in the Pusan area.

**Turdus sibiricus sibiricus*. Siberian Thrush. A single immature male which I purchased in a small bird shop in Seoul on July 19, 1948, was my sole encounter with this species.

Turdus hortulorum. Gray-backed Thrush. I purchased a single male in a small Korean bird shop in Seoul on March 7, 1948. It survived in a small cage for several weeks, and daily throughout the spring poured forth a rich, full song. This song consisted of a series of short, choppy warbled phrases, each repeated once and separated by short pauses. In both timbre and rhythm it was not unlike the performance of the Brown Thrasher (*Toxostoma rufum*) in the eastern United States. I did not observe this species in the field.

**Turdus naumanni*. Oriental Dusky Thrush. Common winter resident in wooded areas throughout the Seoul area, generally noted singly or in small groups up to five in number. In all its actions, it reminds me of the American Robin. I frequently found it among the deciduous ornamental shrubbery around the Chosun Hotel in the very heart of the city and in a small wooded patch behind the capitol building. This thrush was usually of a confiding nature when found within the city limits and often permitted close and extended study. A single dead male purchased in Seoul on February 29, 1948, is now a skin in the United States National Museum. Mr. Herbert G. Deignan identified it as *T. n. eunomus*; however, the nominate race is the common winter form (Austin, 1948:206).

Monticola solitarius. Blue Rock-Thrush. I observed a single male on March 28, 1948, perched on a large rock on the summit of a ridge on Chollyando directly opposite the city of Pusan at an elevation of approximately 1300 feet. The bird was quite tame and permitted close study. An occasional raising and lowering of the tail appeared to be a characteristic action. A single caged immature bird was observed in a small Korean bird shop in Seoul on July 19.

**Phoenicurus auroreus auroreus*. Slaty-crowned Redstart. Presumably winter resident, five males being observed in the vicinity of Seoul between January 1 and February 23, 1948. One male observed on January 10 in a small wooded area directly behind the capitol building in Seoul was in company with a small group of Great Tits, Tree Sparrows and Yellow-throated Buntings. Three males were observed in the Pusan area, one each on March 21 and 28 and on August 1 of the same year. This species was generally seen in low underbrush or perched on the lower branches of small trees. I failed to observe females at any time.

Phylloscopus coronatus. Crowned Willow Warbler. Common summer resident in low wooded mountains five miles north of Pusan from April 18 until September 12, 1948. They were frequently seen in company with Great and Long-tailed tits. Apparently they were in height of the song season from late April until early June. Presumably this species nests in this area although I observed neither nests nor young.

Urosphena squameiceps. Short-tailed Bush Warbler. Common summer resident in low wooded mountains five miles north of Pusan. Usually they frequent the tops of such trees as pine, chestnut, oak and alder. The wiry, high-pitched, insect-like song and short tail are distinct field marks. They were in full song between late April and early June. An adult with food in its bill and six well-feathered young were observed on June 6, 1948.

Terpsiphone atrocaudata. Japanese Paradise Flycatcher. A single male was observed on May 30, 1948, on a rocky, wooded mountain slope at approximately 1000 feet elevation some 15 miles northeast of Pusan. This bird attracted my attention by its song which consisted of a series of rapidly repeated mellow whistled calls not unlike the more mellifluous portion of the song of the Cardinal of the eastern United States. The bird was readily decoyed to within four or five feet of me by an imitation of its call. It also gave voice to a cat-like mewing cry between portions of the whistled song. Another male was observed in a grove of pine trees on September 6, approximately five miles north of Pusan. This latter bird was in company with a flock of some 25 Long-tailed Tits and was observed to make several playful aerial sorties upon them from time to time. It failed to utter a single note during the entire time it was under observation.

Hemichelidon griseisticta. Gray-spotted Flycatcher. Common fall migrant in low wooded mountains five miles north of Pusan. They were observed from August 28 until September 15, 1948, and were silent and quite fearless.

Siphia mugimaki. Japanese Robin-Flycatcher. On October 7, 1948, a total of approximately 17 was observed feeding on small black berries of an osier-like tree in park-like grounds surrounding the Seoul Zoological Gardens. Only two appeared to be males in breeding plumage. The others were of a lighter gold color on the breast and had gray upper parts.

Muscicapula cyanomelana. Japanese Blue Flycatcher. Two males were observed in low wooded

mountains five miles north of Pusan on April 24, 1948. One of these was in full song. Again, on September 12, in the same general area, two males were seen. The species was not noted in the Seoul area.

Prunella collaris. Alpine Accentor. A single bird was observed on October 19, 1947, perched on a large granite boulder on the summit of Pukhansan, a peak some 3000 feet in elevation and approximately seven miles north of Seoul. The bird, which was probably a migrant, was quite tame and wholly silent during the period of observation.

**Prunella montanella*. Mountain Accentor. A single individual purchased in a bird shop in Seoul on September 26, 1948, was my sole encounter with this species.

Anthus spinoletta. Water Pipit. A group of six was observed on March 6, 1948, feeding on the ground along the edge of a large pond near Pier 3, Pusan. They appeared quite dirty and bedraggled from frequenting the refuse and rubbish heaps scattered all around the Korean shacks in that area.

Motacilla alba. Pied Wagtail. Common along nearly all the streams and canals in the vicinity of Seoul from January 3 until at least the time of my transfer to Pusan in the middle of March, 1948. Common in the Pusan area from early April until the end of May and again from late August until the latter part of September. Strangely enough I failed to record this species from May 29 until August, although I observed individuals in full song on April 10, apparently establishing nesting territories among rock piles above the city. In view of these facts it is difficult to say whether it actually nests in the vicinity of Pusan.

Motacilla cinerea. Gray Wagtail. Regular summer resident along small streams in the mountains north of Pusan; present from early April until my departure in early October, 1948. Anxiety and concern of certain individuals observed during late May and early June may have indicated either a nest or young in the vicinity, although I failed to locate either.

Dendronanthus indicus. Forest Wagtail. One was observed in full song on May 31, 1948, along the coast some 15 miles northeast of Pusan and others, also singly, in low wooded mountains five miles north of Pusan on August 11 and 15 and September 6. These latter were all silent except for certain metallic scolding notes. Pine and cryptomeria trees seemed to be most favored retreats.

Lanius bucephalus. Bull-headed Shrike. A single dead male purchased in the South Gate Market in Seoul on February 29, 1948, was prepared and is now in the United States National Museum. H. G. Deignan identified the specimen as belonging to the nominate race.

Lanius cristatus. Red-tailed Shrike. Common summer resident; observed regularly from May 19 until the middle of September, 1948, in pine groves and on barbed wire fences along open weed fields five miles north of Pusan. Well-feathered immature birds were seen on August 1 and 4 and on September 6 and 12. Large field insects, such as grasshoppers, seemed to form a large part of their diet since I often saw individuals drop into the weeds and return to a position along the barbed wire fence near my billet to feed.

**Sturnia philippensis*. Red-cheeked Myna. A single immature bird was purchased in a Korean bird shop in Seoul on July 19, 1948; it succumbed the next day upon my return to Pusan. The skin is now no. 117740 in the collection of the Museum of Vertebrate Zoology. I never observed it in the field. Austin (1948:248) states that "This species is a straggler from the southward, having been taken but twice."

Zosterops palpebrosa. Oriental White-eye. A single bird was observed on May 9, 1948, in a chestnut tree on a wooded hillside approximately one and a half miles south of Agasaki near Pusan. It was probably a migrant.

**Passer montanus dybowskii*. Eurasian Tree Sparrow. Abundant permanent resident in the vicinity of both Seoul and Pusan. More than 100 were observed strung up on straw ropes for sale in the South Gate Market Place in Seoul on February 1, 1948. Apparently a favorite food item of the natives.

Eophona migratoria. Black-headed Hawfinch. A common cage bird in the city of Seoul from the middle of July until early October, 1948. Wolfe reported this species as fairly common and nesting in the Seoul area during the summer.

**Chloris sinica ussuriensis*. Oriental Greenfinch. A flock of 25 was observed perched on electric wires alongside a road some 15 miles southwest of Seoul on February 23, 1948. This species is a common cage bird in the city of Seoul and a regular although never common summer resident in the vicinity of Pusan. One was observed carrying a large dry leaf as though in the process of nest building on April 18, 1948, in low wooded mountains five miles north of Pusan.

Carduelis spinus. Eurasian Siskin. Two were observed in a small Korean bird shop in Seoul on March 7, 1948. A single bird was seen in the same shop on July 19 and again on September 26. Although I tried to purchase the last two, the old shopkeeper flatly refused to part with them, implying that they were quite rare. I never observed it in the field, a circumstance which parallels Austin's (1948:254) statement, "The winter of 1945-46 was evidently one of its off years, for though I looked for it constantly, I never found it."

**Fringilla montifringilla*. Brambling. Eight caged birds were observed in a small Korean bird shop in Seoul on March 4, 1948. Fukusei Cho, the director of the National Science Museum in Seoul, gave me a single male collected on the Museum grounds on March 4, 1948. Two observed in low wooded mountains some five miles north of Pusan on April 18, 1948, constituted my sole field contact with the Brambling.

**Emberiza rutila*. Chestnut Bunting. Common cage bird in the city of Seoul during July, September, and October, 1948. A male which I purchased in Seoul on July 19 proved to be an excellent singer even during the hot summer months and survived for six months. I never observed the species in the field.

**Emberiza elegans elegans*. Yellow-throated Bunting. Common in small flocks of five to 15 in wooded areas throughout the Seoul area from the latter part of November until the time I was transferred to Pusan in mid-March. It also appeared to be a common cage bird in Seoul. This bunting proved to be a fairly common summer resident in low wooded mountains some five miles north of Pusan from late March until early September. Two pairs which I observed in that area on June 6 appeared particularly anxious and fairly flew into a frenzy when I "kissed" the back of my hand in imitation of a distressed bird. This occurrence naturally led me to believe that they were nesting in the vicinity although I failed to find any more definite proof.

**Emberiza cioides*. Meadow Bunting. Easily the most abundant bunting throughout the entire countryside of south Korea. Common in groups of two to ten in patches of weeds and low underbrush throughout the Seoul area during the entire winter of 1947-48, often being observed in company with small groups of Yellow-throated Buntings. It was also a common cage bird in Seoul. In the vicinity of Pusan it was common from the time of my arrival in March until my departure in October. The courtship period there seemed to be at its height about April 25, although I observed an immature bird well-feathered and out of the nest on May 9. A male taken 10 miles east of Seoul on February 8, 1948, was determined by H. G. Deignan as representing the race *weigoldi*, while another male, taken seven miles south of Seoul on February 15, represents *castaneiceps*. According to Austin (1948:264), the latter subspecies is the one to be expected in summer in central and southern Korea.

**Emberiza rustica rustica*. Rustic Bunting. Common winter resident in fairly large flocks throughout the rural areas in the vicinity of Seoul. Two were collected for me by L. R. Wolfe from the top of a tall leafless tree about seven miles south of Seoul on February 15, 1948. Austin (1948:267) also "found it by far the commonest of the wintering small birds in the Suwon area" and called it "an abundant winter visitor from Kyonggi Do southward."

**Emberiza tristrami*. Tristram Bunting. I purchased a single male in a Korean bird shop in Seoul in early January, 1948. It succumbed two months later and I saved it as a specimen. I never observed the species in the field.

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FROM FIELD AND STUDY

A female Sooty Grouse (*Dendragapus fuliginosus*) near sagebush (*Artemisia tridentata*). Photograph taken on Rush Creek, south of Mono Lake, Mono County, California, June 2, 1948, by Ed Harrison and Frances Roberts.

Notes on the Occurrence and Behavior of the Stilt Sandpiper on Vancouver Island.—The Stilt Sandpiper (*Micropalama himantopus*), though decidedly rare on Vancouver Island, may be a regular migrant along the inner shore-line in the late summer. Munro and Cowan (A Review of the Bird Fauna of British Columbia, 1947:111) describe it as a "Scarce transient, more often seen in the interior than on the coast" and give no records for Vancouver Island.

During the past fifteen years I have observed the Stilt Sandpiper in the Comox district of Vancouver Island in the years 1937 (two individuals), 1942 (two), 1945 (four), 1947 (one), 1949 (one), and 1951 (one, on August 19). The occurrences were during the latter part of August or the first half of September, and the birds were in company with some or all of three other species, the Dowitcher (*Limnodromus griseus*) and Greater and Lesser yellow-legs (*Totanus melanoleucus* and *T. flavipes*).

The Stilt Sandpiper is most likely to be confused with the Lesser Yellow-legs, as the birds are similar in appearance when flying or feeding on land and have similar calls. Closer examination shows that the Stilt Sandpiper, at least in early fall as here reported, has more brown color in the plumage, contrasting with the gray of the yellow-legs, and has conspicuous, light colored superciliary lines which often join across the forehead. The beak is noticeably shorter and blunter than that of the yellow-legs, but the slight thickening and downward curve near the tip are not very apparent in the

field. The color of the legs of the juvenal Stilt Sandpiper is not always diagnostic; in the case of the 1951 bird, the only noticeable difference was that the color was not as bright as the yellow of the yellow-legs. Various authors give greenish or colors intermediate between green and yellow, and, in the birds seen here, a tinge of green was generally apparent except in the 1951 bird; but to state that green legs are diagnostic, as some writers do, is incorrect.

All the Stilt Sandpipers seen on Vancouver Island, except two on August 19, 1937, showed a decided buffy tinge on the breast and flanks, indicative of juveniles. I originally recorded these two 1937 birds as juveniles also, but later concluded that they were adults which still showed some of the summer barring on the breast and flanks. The bird seen on the latest date, September 11, had more gray in the plumage, presumably due to a more advanced stage of molt.

My experiences as to general behavior of the Stilt Sandpiper concur with the descriptions in Bent (U. S. Nat. Mus. Bull. No. 142, 1927:126) and Forbush (Birds of Massachusetts and other New England States, vol. 1, 1925:401). Foraging is done primarily by probing like the Dowitcher; and, like that species, the body is often immersed up to the shoulders. The individuals observed here exhibited a tendency to stay in the same place, the 1951 bird and others being observed for over an hour, during which time they did not move from an area of about 30 square yards. They were generally sedate in actions as compared with the fussy yellow-legs. When its shoulders were immersed, the 1951 bird would on occasions kick with its legs in the endeavor to reach the food, just as some surface-feeding ducks do. Although I could not determine positively that both feet were off the bottom at the same time, it certainly appeared so. On the one occasion when they were seen feeding on a sandy foreshore, the Stilt Sandpipers did not wade in like their companions the Dowitchers, but probed into the water-covered sand.

The 1951 bird was the only one that showed resentment at the presence of another bird feeding near it. There would, generally, be one or more Lesser Yellow-legs feeding in the same area. Sometimes the Stilt Sandpiper would take no notice and both birds would feed peaceably close together; but, on other occasions, when the Yellow-legs settled and started to feed, the sandpiper would at once fly toward it, drop into the water one or two feet away, and assume a very defiant attitude with the head drawn back and depressed into the neck, the beak pointing downward and touching the surface of the water and the body slightly submerged. If the Yellow-legs did not fly off, the sandpiper would fly toward it and both birds would rise in the air a few feet in fighting attitude, the legs and feet being stretched out toward the other as though threatening to strike; but I did not see any actual attempt to strike by either bird. The Yellow-legs would then retire. Once, when a Yellow-legs settled some yards away, the Stilt Sandpiper at once attacked it and drove it away. The fight, if it could be so described, would generally take place close in-shore where the water was only inches deep, but on one occasion the birds drifted out; and, when the Stilt Sandpiper dropped down into water too deep for it to wade, it swam inshore, seemingly quite adept in so doing. In one instance the Yellow-legs, on the approach of the Stilt Sandpiper, lowered one of its wings in a defensive attitude but this did not deter the Stilt Sandpiper, and the Yellow-legs then left without further argument.

Whether it was one particular Yellow-legs that caused these reactions in the sandpiper, it was quite impossible to say; but it would often take no notice of a Yellow-legs flying in and the two species would then feed side by side. There must have been three or four of these encounters during the hour of observation. A juvenal Dowitcher feeding in the same area was never attacked.

When in the aggressive attitude the bird kept up a continuous low sizzling, distinctly threatening note with the beak slightly open. This note would be intensified during the attack together with the noisy call very similar to that of the Yellow-legs. Generally speaking, however, the Stilt Sandpiper is a quiet bird. It seldom makes use of the noisy note similar to that of the Lesser Yellow-legs; and, apart from those mentioned, the only notes heard from it have been the following: (1) when feeding, a low *kurk-wik*, or *quick*, sometimes repeated; (2) on taking wing sometimes, a note like the *kip* of the Lesser Yellow-legs, but much subdued; (3) at another time a very soft *purwee* and a low rolling *gurr* were heard.—THEED PEARSE, *Comox, Vancouver Island, British Columbia, September 14, 1951.*

New Records of Birds from Chiapas, Mexico.—With the appearance of part one of the "Distributional Check-List of the Birds of Mexico" by Friedmann, Griscom, and Moore (Pac. Coast

Avif. No. 29, 1950), I have been able to note that a number of species, listed below, apparently have not been recorded from Chiapas or, although known to occur, have not yet been recorded as breeding species. From my field data some of these gaps can be filled. I am indebted to Dr. Frank A. Pitelka for reading the original manuscript and for making suggestions about additions or detailed information.

Fregata magnificens. Magnificent Man-o'-war Bird. Breeds in great numbers on the sea coast; large colonies observed breeding from October to March on several islets of the Mar Muerto, near Arriaga.

Hydranassa tricolor. Tricolored Heron. Observed from September to April and found breeding in September, in 1942, 1944 and 1950, in the salt marshes of the Mar Muerto, Arriaga; observed also in December, January and February on the Chiapas River, near Tuxtla Gutierrez.

Nycticorax nycticorax. Black-crowned Night Heron. Small breeding colonies found from September to November of several years in the marshes of the Mar Muerto, Arriaga; observed also on the rivers near Tuxtla Gutierrez, near which the species apparently breeds as nestlings hardly capable of flight have been found on the Rio Sabinal.

Ixobrychus exilis. Least Bittern. One male collected on September 3, 1949, at El Cocal, Tuxtla Gutierrez; another individual seen on December 22, 1950, near La Chacona, Tuxtla Gutierrez.

Jabiru mycteria. Jabiru. One female collected at Rio de Chiapa, Chiapa de Corzo, February 15, 1947; and a pair seen at Punta Lin, La Gloria, Arriaga, November 25, 1950.

Cairina moschata. Muscovy Duck. Individuals observed at Punta Lin, La Gloria, Arriaga, in November of several years; small flocks seen at Rio Jatate, Ocosingo, in April, 1944, and at Rio de la Venta, Quechula, April, 1945.

Spatula clypeata. Shoveller. Small flocks seen daily during a stay at La Gloria, Arriaga, from November 20 to December 10, 1950

Oxyura jamaicensis. Ruddy Duck. I identified two females and one male killed by a local hunter, January 13, 1951, at Punta Lin, La Gloria, Arriaga.

Elanoides forficatus. Swallow-tailed Kite. Breeds regularly from April to July in the neighborhood of Villa Allende. It arrives in March and leaves in early September. Also I found it breeding near Pueblo Nuevo Solistahuacan in May, 1951.

Buteo albonotatus. Zone-tailed Hawk. I collected one immature male, September 20, 1947, near Tuxtla Gutierrez, and one adult male, December 5, 1950, at La Gloria, Arriaga. This hawk is seen frequently during autumn and winter near Tuxtla Gutierrez, Cintalapa, Ocozocoautla, and Suchiapa. In November I have seen it many times killing nestlings of the Roseate Spoonbill on islets in the Mar Muerto, La Gloria, Arriaga.

Buteo swainsoni. Swainson Hawk. Very large flocks have circled over Tuxtla Gutierrez and Villa Allende on their southward flight during autumn of some years, as in 1947 and 1949.

Falco columbarius. Pigeon Hawk. One male collected December 4, 1950; several individuals seen daily during a stay at La Gloria, Arriaga, from November 20 to December 10, 1950; again four individuals seen at the same locality, January 13, 1951.

Penelope purpurascens. Crested Guan. Very common, the year around, in the forests of Chiapas, except possibly those of the highlands; seen and collected at El Ocote, Ocozocoautla; El Mercadito, Cintalapa; Rio de la Venta, Quechula; El Jordan, Ocosingo; La Angostura, Villa de Acala.

Columba speciosa. Scaled Pigeon. Found to be more or less common from March to August at El Ocote, Ocozocoautla, for many years; recorded breeding there in May.

Ara militaris. Green Macaw. Small flocks of three or four were seen occasionally at La Gloria, Arriaga, from March 15 to 30, 1943. Again I saw one pair on March 11, 1951, at the same locality.

Chordeiles minor. Nighthawk. I collected two males, April 24, 1949, and one female with a newly hatched chick, July 2, 1949, at Santa Julia, Ocozocoautla. I found another pair breeding on June 25, 1947, at Meseta de Copoya, Tuxtla Gutierrez. Around Tuxtla the species is seen often in spring and summer.

Caprimulgus maculicaudus. Spot-tailed Whip-poor-will. I collected one specimen at Santa Julia, Ocozocoautla, April 24, 1949; it was sent to the Academy of Natural Sciences of Philadelphia.

Panyptila sanctihieronymi. Swallow-tailed Swift. Common in spring and summer around Tuxtla Gutierrez, where flocks may be observed in the afternoons, mainly after rainy weather, and also in the early mornings. The call of this swift is easily identified; it is very similar to the call of a domestic

chick lost from the hen. In spite of difficulty in securing specimens, I have no doubt in referring these swifts to the above species, and not to *cayennensis*, because of the large size. One female collected from a large flock on August 2, 1944, has the following measurements: wing, 188 mm.; tail, 88; culmen, 7. This Guatemalan species has not been recorded from Mexico previously.—Miguel Alvarez del Toro, *Museo Zoologico, Tuxtla Gutierrez, Chiapas, Mexico, September 25, 1951.*

Additional Records of Cuculus in North America.—The status of the genus *Cuculus* in North America has been reviewed by Deignan (Condor, 53, 1951:154-155) on the basis of three specimens from Wales, St. Paul Island, and St. Lawrence Island, Alaska. After re-examination of these specimens, it was concluded that *Cuculus canorus bakeri* is not represented in the North American fauna and that all three specimens must be referred to *Cuculus saturatus horsfieldi*.

Since this study was made in the interest of the A.O.U. Committee on Classification and Nomenclature, I should like to add two more records for consideration. One of these is a second specimen from St. Lawrence Island, collected by Howard Ataglook near Gambell on July 14 or 15, 1935. This was previously identified (by Dr. Harry C. Oberholser) as *bakeri* and was so recorded in my list of the Birds of St. Lawrence Island, Alaska, Appendix 5, in "Archeological Excavations at Kukulik, St. Lawrence Island, Alaska," by Geist and Rainey, volume 2, Miscellaneous Publications of the University of Alaska, 1936.

On June 29, 1937, Mr. John Steenis, a member of our Fish and Wildlife Service field party investigating the Aleutian Islands, collected a cuckoo at Rat Island. Dr. S. Dillon Ripley kindly examined the specimen and referred it to *Cuculus saturatus horsfieldi*, and it is so recorded in my unpublished manuscript on the fauna of the Aleutian Islands.

Recently I forwarded the second St. Lawrence Island specimen, referred to above, to Mr. Allen J. Duvall, at the United States National Museum, for further examination. Mr. Duvall reports as follows: "Bert Deignan and I have examined the specimen of *Cuculus* transmitted under your letter of August 26. We are of the opinion that it is not *C. canorus* but *C. saturatus horsfieldi*. The bird in question is the same race as the specimen taken by Mr. Steenis in the Aleutian Islands and we, therefore, now have five specimens, all referable to the same species."—Olaus J. Murie, *The Wilderness Society, Moose, Wyoming, October 15, 1951.*

Aberrant Heermann Gulls at Pacific Grove, California.—Because of interest in aberrant Heermann Gulls (*Larus heermanni*) which was stimulated by the paper by Hubbs and Bartholomew (Condor, 53, 1951:221-227), we paid particular attention to this species during two hours of observation of water birds at Mussel Point, on Monterey Bay, close to the Hopkins Marine Station in Pacific Grove, California, on October 8, 1951. Counts of Heermann Gulls perched on the rocks within a range of about 100-200 yards from our point of observation yielded up to 213 individuals. In addition to these there was a flow of scattered birds and small groups flying east or west close enough to observe adequately the wing pattern. For part of the time there was a large concentration of this species offshore. At first these gathered at some distance to the east, circling, alighting, resting on, or rising from the water in close formation, apparently feeding on some organism which made a sudden appearance at the surface. This mass of birds gradually moved westward opposite to us, then came in close to the rocks. In general, this behavior of large numbers of Heermann Gulls is not unusual in late summer and early autumn in the Monterey region. In the present instance we could do no more than guess at the number in the group and agreed it might have been 1000 or 1500. Individuals in this dense concentration could have been drawn from among those previously counted on the rocks or from among those which had been flying past us. Any attempt to arrive at a more accurate estimate of the total number of all Heermann Gulls seen would be futile.

Among those flying past, alighting on, or springing up from the rocks, and in the feeding flock over the water there were at least five individuals with white wing patches such as those described by Hubbs and Bartholomew. It might be supposed that because of local wandering, and because no two white-patched birds were seen simultaneously, some of these five were repeat observations of the same individuals. But we found that symmetry and asymmetry in the presence and size of the patches rendered the birds distinguishable. The five distinct patterns were as follows: equal size patches on each wing, patches on each wing but decidedly larger on right, patches on each wing but decidedly larger on left, patch on left wing but none on right, patch on right wing but none on left. Individuals

were subsequently noted with patterns similar to numbers 1, 2, and 3 (one observation for each). In these cases there was no way of determining whether they were repeats, or different birds with similar patterns.—WILLIAM M. PURSELL, *Berkeley, California,* and LAIDLAW WILLIAMS, *Carmel, California, October 26, 1951.*

Chestnut-backed Chickadee in the Sierra Nevada.—On June 17, 1951, a flock of five Chestnut-backed Chickadees (*Parus rufescens*) was seen along the Big Trees Trail in Calaveras Big Trees State Park, Calaveras County, California, at an elevation of about 4700 feet, by nine members of the Golden Gate Audubon Society (Gull, 33, 1951:27). The birds were observed at close range in good light for about 15 minutes. There was no sign of a white eye-stripe on any of the birds; the chestnut patch on the back was seen on several of the birds as well as the brownish wash on the flanks. [New locality records of this chickadee supported by specimen evidence should be sought in the future.—Editor.]—A. LAURENCE CURL, *El Cerrito, California, June 20, 1951.*

Sabine Gull at Mono Lake, California.—On September 16, 1951, while standing on the shore of Mono Lake in Mono County, California, watching the thousands of grebes and phalaropes, I was surprised to see a Sabine Gull (*Xema sabini*) flying low over the water and close to me. Size, shape, and color were all carefully checked through high-power binoculars although the bird was close enough for determination of species with the naked eye. It was interesting to note the dark head even at this late date. Searching the literature I find only one record for this same locality, that cited by Grinnell and Miller (Pac. Coast Avif. No. 27, 1944:171) as follows: "at Mono Lake, Mono County, in September, 1901 (W. K. Fisher, Condor, 4, 1902:10)."—EARLE R. GREENE, *Oxnard, California, October 3, 1951.*

The Painted Redstart at Santa Barbara, California.—On October 9, 1951, I was called by Mr. Waldo G. Abbott of the Santa Barbara Museum staff to come down to verify his identification of two Painted Redstarts (*Setophaga picta*). One bird was taken, a male in full plumhge. The specimen is now in our systematic series in the bird hall, and is catalogued as no. 4048.

These birds apparently had been in the area for about a week, because a resident of the neighborhood said she had seen two birds which she described as Painted Redstarts. On October 9 the birds were in almost the exact place where Mrs. Cooke reported seeing one the preceding January (Condor, 53, 1951:205).—EGMONT Z. RETT, *Santa Barbara Museum of Natural History, Santa Barbara, California, October 23, 1951.*

Wood Ibis in New Mexico.—On September 2, 1951, John G. Bamesberger and the writer observed three immature Wood Ibises, *Mycteria americana,* at a small marsh near Bernardo, Socorro County, New Moxico. One of these, a male, was collected and is now no. 124846 in the collection of the Museum of Vertebrate Zoology. To the best of my knowledge this represents the first specimen of Wood Ibis taken in the state and the only recorded observation since 1854 when Henry observed a flock near Fort Thorn (Bailey, Birds of New Mexico, 1928:94). Fort Thorn is near the present town of Rincon, Dona Ana County, New Mexico. Bernardo is about 130 miles north of Rincon.—A. E. BORELL, *Albuquerque, New Mexico, October 25, 1951.*

Leconte Sparrow in Western Montana.—A group of Leconte Sparrows (*Passerherbulus caudacutus*) was discovered on July 16, 1950, at Camas Creek on the western side of Glacier National Park, Montana. At least four males were singing from definite locations. The birds were found in an isolated wet meadow about half a square mile in extent and containing the introduced timothy grass (*Phleum pratense*) and redtop (*Agrostis alba*). The native plants are primarily *Alopecurus alpinus, Scirpus microcarpus, Carex crawfordi, C. scoparia, Camassia esculenta* and *Senecio triangularis.* A singing male with fully enlarged testes was collected and is now at Montana State University on indefinite loan.

Additional observations were obtained in 1951. No bird was seen at Camas Creek by Robert Lechleitner on June 15 nor by Davis and Lechleitner on June 25. However, on July 16 several birds were singing at Camas Creek and a nest with five eggs was found in an extensive meadow some eight miles to the northwest and four miles southeast of Logging Ranger Station. During the month of July an unsuccessful search was made for Leconte Sparrows in available wet meadows in Glacier

National Park and Waterton Lakes National Park in Canada. However, not all such meadows were seen and it seems likely that the birds occur in some isolated areas.

The Leconte Sparrow has been recorded from only three counties (Roosevelt, Phillips, and Sheridan) in the eastern part of the state (Hotchkiss, Condor, 50, 1948:274-275). It is reported in the A.O.U. Check-list (1931) as accidental in Idaho, Utah, and Colorado. The original references indicate that these occurrences were probably accidental and do not indicate the possibility of breeding. In Alberta a specimen was observed by Clarke in May, 1930, in the foothills between Calgary and Banff (letter from W. Earl Godfrey, National Museum of Canada). The species occurs regularly in the northern part of Alberta.

It is noteworthy that this species arrived so late in the season at Glacier National Park. One wonders if the species has spread south from northern Alberta and if it retraces in migration its possible ancestral route of dispersion.—DAVID E. DAVIS, *Montana State University Biological Station, Missoula, Montana, October 26, 1951.*

Inland Record of the White-winged Scoter from California.—The White-winged Scoter (*Melanitta fusca*), a winter visitor along the sea coast of California, has been recorded only three times in that state from inland fresh-water localities. These are Lake Tahoe, southwestern Ventura County, and Redlands (Grinnell and Miller, Pac. Coast Avif. No. 27, 1944:89). Only one specimen was taken, that at Lake Tahoe. Thus it is considered well to record that on October 28, 1951, Mr. Louis Cass shot an adult female from an irrigation pond on the Pauba Ranch at Temecula, Riverside County, California. The writer was present and identified the bird, which will probably be mounted and form a part of the collection of ducks which have been found on the ranch.—J. R. PEMBERTON, *Los Angeles, California, October 29, 1951.*

A Second November Nest of the California Thrasher.—Sargent (Condor, 42, 1940:54) noted adult California Thrashers (*Toxostoma redivivum*) carrying food to a nest at Pasadena, California, between November 8 and 16, 1935. The first of the two young left the nest on November 26. This is the earliest recorded nesting of this species. On November 12, 1951, Miss Helen S. Pratt notified me that she had recovered on that day two deserted nestling California Thrashers from a nest at 2451 Ridgeview Avenue, Los Angeles, California. The smaller of the two had subsequently died. Miss Pratt kindly gave me the dead nestling which I preserved as a formalin specimen. She is raising the other bird, which appeared in excellent condition at the time of my last visit on November 19, 1951.—JOHN DAVIS, *Moore Laboratory of Zoology, Occidental College, Los Angeles, California, November 20, 1951.*

Winter Record of the Warbling Vireo in California.—On December 29, 1951, we were surprised to find a Warbling Vireo (*Vireo gilvus*) on the campus of the University of California at Berkeley. The bird was foraging a little above our heads in a toyon shrub (*Photinia arbutifolia*) at the edge of a strip of broad-leaf vegetation growing alongside a small stream. It came to within 15 feet of both observers, and its vireonine form and movements together with markings characteristic of this species were so obvious that we felt no doubt whatever of its identity. A Hutton Vireo (*Vireo huttoni*) conveniently appeared close by the Warbling Vireo, affording an easy comparison of the two. Both vireos moved away and became lost in the vegetation, apparently following a flock of juncos (with which the vireos were originally associated).

On December 12, 1951, Keith L. Dixon observed what he believed to be a Warbling Vireo in precisely the same location. This observation was made under similar conditions.

Mr. Chandler S. Robbins has examined the bird-distribution files of the U. S. Fish and Wildlife Service and has kindly informed us of previous winter observations of the Warbling Vireo in the United States. All these are sight records, summarized as follows: (Florida: January 7, 1917, Royal Palm Hammock (noted by H. R. Mills, O. E. Baynard and Mrs. Hiram Byrd; reported by Howell, Auk, 38, 1921:261); December 23, 1933, Sarasota (Anne Perkins). (2) Texas: December 25, 1934, Hot Springs, at junction of Tornillo Creek and the Rio Grande River (Mrs. Lovie Whitaker, MS notes); December 23, 1950, Harlingen (L. I. Davis, *et al.*, on Christmas bird count).

Despite the fact that no one has a specimen to back up any of the foregoing records, it seems certain that the species does occasionally winter in the United States. Collection of specimens in winter

is of course desirable and would support this view.—ROBERT A. NORRIS *and* DAVID W. JOHNSTON, *Museum of Vertebrate Zoology, Berkeley, California, January 25, 1952.*

Wren-tit Attempts Copulation with Begging Fledgling.—The resemblance between the posture of a begging passerine fledgling and that of an adult female during courtship, has often been noted. Both the begging fledgling and the adult female assume a crouching position accompanied by a fluttering of the wings. The function of the posture in the fledgling is to release the feeding response of the adults. In the female the posture is usually indicative of a readiness to copulate. In many species the male of a pair feeds the crouched, fluttering female. This act of "courtship feeding" has been discussed by Lack (Auk, 57, 1940:169-178) and by Armstrong (Bird Display and Behaviour, 1947: 43-50). Courtship feeding may precede or accompany copulation.

On June 5, 1951, an adult Wren-tit (*Chamaea fasciata*) accompanied by two begging fledglings came to a feeding tray less than 10 feet from my point of observation. The adult fed each fledgling twice, then mounted one of the crouching, fluttering fledglings in copulatory position. It remained on the fledgling's back for approximately 2 seconds before hopping off to resume feeding the youngsters.

This observation lends support to the belief that the pre-copulatory display of the female in many passerines is truly similar to the begging display of the fledgling. Both postures seem capable of releasing copulatory behavior in the Wren-tit.—CHARLES G. SIBLEY, *San Jose State College, San Jose, California, January 15, 1952.*

Tyrannus melancholicus in Marin County, California.—On October 21, 1951, near Drake's Bay in Marin County, California, my attention was attracted by a large flycatcher flying from a fence post. As it turned and showed a yellow belly, I recognized it as a kingbird; and since it did not have white lateral tail edges, I assumed that it was a Cassin Kingbird (*Tyrannus vociferans*), which in itself would be noteworthy at this location. Therefore, without detailed study, the bird was collected; but it proved to be the second specimen taken in California of the Tropical Kingbird, *Tyrannus melancholicus*. It was a female; and although the skull was completely double-roofed, the lack of any brightly colored crown feathers and of emarginations of the primaries, the extensive buff edges on the wing coverts and smaller ones on the rectrices, and the small ovary all indicate that it was a bird of the year. On the basis of its short length of wing (right, 106.5 mm.; left, 108.3), it seems referable to *T. m. occidentalis*, and it agrees well in coloration with a series of this race in the collection of the Museum of Vertebrate Zoology except for a few clear yellow feathers mid-ventrally in the yellowish olive-green pectoral band which is also somewhat darkened laterally. Other measurements of this specimen, now M. V. Z. no. 124640, are as follows: tail, 91.4 mm.; exposed culmen, 20.7; bill from nostril, 17.5; and tarsus, 19.9.

This kingbird had apparently been foraging from fence posts at the edge of a long, disked stubble field some 100-150 yards wide which lies between grass- and low, shrub-covered hills. A strip of 20-30 foot red alders and somewhat shorter willow thickets separates the field from the hills on the east, whereas only the road and a few feet of weeds lie between the fence line and the hills on the west. The stomach of this bird was crammed with the hard parts of insects among which the orders Orthoptera (Acrididae), Coleoptera and Hymenoptera were identified. It was moderately fat and weighed 43.6 grams.

Previous casual occurrences of this species northward from its normal range in southern Arizona, southern Texas and tropical America are summarized, and one subspecific identification corrected, by Slipp (Auk, 59, 1942:310-312). Noting that the then known far northward vagrant occurrences were all coastwise (3 Pacific, 1 Atlantic), Slipp suggested that "in the juvenile males (and, perhaps in both sexes) of at least two of the named races of this species there is a tendency to wander northward along the ocean coasts in fall and winter." The specimen taken by Russell (Condor, 50,1948:90) in Berkeley, California, on October 1, 1947, also an immature judging from the plumage, and the one here reported are females. On the same date as this Berkeley occurrence, an individual of this species was seen by Gale Monson (Condor, 51, 1949:264) on the Arizona-California line above Topock, Arizona. It would seem that northward wandering vagrants of this species might be fairly commonplace in October and November, at least toward the Pacific coast.—HOWARD L. COGSWELL, *Museum of Vertebrate Zoology, Berkeley, California, November 15, 1951.*

NOTES AND NEWS

Wilson C. Hanna, member of the Cooper Ornithological Club since 1902, past president of the Southern Division and member of the Board of Governors.

The Wilson Ornithological Club is again offering a Louis Agassiz Fuertes Grant in 1952. This grant of $100 is especially intended to assist young ornithologists in their research projects. Grants are awarded on the basis of the merits and promise of the research project as appraised by the Wilson Club Research Committee. Application forms will be sent on request and must be returned to the chairman of the committee, John T. Emlen, Jr., University of Wisconsin, Madison 6, Wisconsin, by March 25, 1952.

The frontispiece of this issue showing the Red-fronted Parrot (*Amazona finschi*) is the seventeenth in the series of paintings by Andrew Jackson Grayson published in the Condor. This plate is given anonymously in honor of Francis H. Rudkin, Sr., of Fillmore, California. Mr. Rudkin, who will be 91 years of age on March 16, is the dean of American aviculturists. He and David Seth-Smith of England are the two oldest members of the British Avicultural Society, which recently conferred honorary membership upon Mr. Rudkin. His counsel and advice in all fields of aviculture are sought by interested persons both here and abroad.

The Red-fronted Parrot was painted by Grayson at Mazatlán in October, 1864. Grayson writes of it as follows: "This handsome and well known species of western Mexico inhabits the region of the Tierra Caliente on the western slopes of the Cordillera, more abundant near the sea coast than in the mountainous regions . . . . The parrots are gregarious, assembling in large flocks and are more numerous in the region of Mazatlán than any other portion of the country that I have visited. The forests in some localities, particularly where some kinds of fruit are in season, appear at times to be alive with them only . . . . They often visit the cornfields or milpas in great numbers, about the time the green corn or maize commences to mature, commiting great depredations and often destroying the small milpas of the native unless they are guarded . . . . In feeding they waste much more than they swallow. In corn for instance they only take the heart or germ, throwing the other parts away . . . . It is remarkable how ingeniously they hull off the parts rejected with their sharp edged under mandible, with which it would seem they could split a hair . . . . They are good climbers, and for this their feet are well adapted. Their hooked beak is a great assistance in pulling themselves from one branch to another."

The food-plant shown in the plate is *Psidium sartorianum*, a member of the family Myrtaceae. The tropical tree producing guava fruit is placed in the same genus.

Because of growing concern about vernacular names of Middle American birds, it may be pointed out here that there are other "red-fronted" parrots. It has been suggested by Eisenmann, Sutton, and others that the name "Lilac-crowned Parrot" be adopted for *Amazona finschi*.

COOPER CLUB MEETINGS

NORTHERN DIVISION

OCTOBER.—The regular monthly meeting of the Cooper Ornithological Club was held on October 4, 1951, in room 2503 Life Sciences Building, University of California, Berkeley. The following were proposed for membership: Leo B. Olson, 835 S. 1st Street, DeKalb, Illinois, and Bayard

C. Auchincloss, 1711 Guilford Lane, Oklahoma City, Oklahoma, by C. V. Duff.

Dr. Paul T. Wilson, of the College of Marin, presented an account of vertebrate animals of the Colorado high country and of the work of investigators at the Rocky Mountain Biological Laboratory.—R. F. JOHNSTON, *Acting Secretary*.

NOVEMBER.—The regular monthly meeting of the Cooper Ornithological Club was held on November 1, 1951, in room 2503 Life Sciences Building, University of California, Berkeley. The following were proposed for membership: Janice R. Bartell, 410 Merritt Ave., Apt. 4, Oakland 10, California, and James N. Bartell, 410 Merritt Ave., Apt. 4, Oakland 10, California, Mrs. O. F. Black, 25 Panoramic Way, Berkeley 4, Calif., all by Junea W. Kelly; Mr. Harold L. Wisner, Scripps Institution of Oceanography, La Jolla, Calif., Ralph S. Palmer, N. Y. State Museum, Albany 1, N.Y., by Frank A. Pitelka.

Dr. Russell T. Congdon spoke on nesting birds of Manitoba, Canada, illustrating his talk with colored motion pictures. The high point of the pictures was some excellent views of the Hudsonian Godwit, both adults and young.—R. F. JOHNSTON, *Acting Secretary*.

DECEMBER.—The regular monthly meeting of the Cooper Ornithological Club was held on December 5, 1951, in room 2503 Life Sciences Building, University of California, Berkeley. The following names were proposed for membership: T. M. Street, 1435 Campus Drive, Berkeley 8, California, by Lois C. Taylor; Robert M. Laughlin, Drake's Corner Road, Princeton, New Jersey, Mrs. Jeanette Courte MacMillan, 3557 Eden Ave., Cincinnata 29, Ohio, and Aaron M. Bagg, 72 Fairfield Ave., Holyoke, Massachusetts, by Frank A. Pitelka; Ruth Campbell, 1810 Virginia Street, Berkeley 3, California, by R. F. Johnston.

A nominating committee, intended to propose a slate of candidates for the Northern Division offices for 1952 was appointed. The committee consists of E. L. Sumner (chairman), Lois C. Taylor, and Howard L. Cogswell.

Dr. Robert E. Bailey, speaking on pituitary functions in birds, summed up the present status of research in the field and also presented some of his own unpublished work.—R. F. JOHNSTON, *Acting Secretary*.

JANUARY.—The regular monthly meeting of the Cooper Ornithological Club was held on Thursday, January 3, 1952, in room 2503 Life Sciences Building, University of California, Berkeley. The following names were proposed for membership: Mr. Robert Dennis, 135 Purdue Ave., Berkeley, Calif., by George Haley; Dr. Jan Hublé, 2321 Blake Street, Berkeley 4, Calif., by Robert E. Bailey; Mrs. Paul A. Stephenson, 815 Colfax, Evanston, Illinois, and Mrs. R. J. Thornburg, Route 2, Box 665, Tuscon, Arizona, both by Junea W. Kelly.

Dr. E. Lowell Sumner, Chairman of the Nominating Committee, presented the following slate of officers for 1952: Dr. Robert T. Orr, President; Dr. Charles G. Sibley, 1st Vice-president; Dr. T. E. Reynolds, 2nd Vice-president; and Mr. Robert I. Bowman, Secretary. No nominations were received from the floor. On a motion by Dr. Alden H. Miller, the slate of officers was accepted and an unanimous ballot cast. Retiring President Junea W. Kelly relinquished the chair to the newly elected President, Dr. Robert T. Orr, who expressed the grateful thanks of the Club to Mrs. Kelly for her excellent work as leader of the Northern Division.

Mr. Keith L. Dixon spoke on bird distribution in Texas.—ROBERT I. BOWMAN, *Secretary*.

SOUTHERN DIVISION

NOVEMBER.—The regular monthly meeting of the Cooper Ornithological Club was held on November 27, 1951, at 8 p.m., 145 Allan Hancock Foundation, University of Southern California. The following names were proposed for membership: Charles H. Allen, Griffith Park Zoo, Box 284, Los Angeles 27, Calif., by William R. Lasky; Harold A. Stanley, 2642 E. 222nd St., Long Beach 10, Calif., by Ross Hardy; Marshall Blackwell Eyster, Dept. of Zoology, Box 545, Southwestern La. Institute, Lafayette, Louisiana, William Jones Jenkins, M.D., P. O. Box 7, Olanta, South Carolina, Dr. Brina Kessel, University of Alaska, College, Alaska, Mrs. Norah Selby O'Neil, 1311 Bonham St., Commerce, Texas, and William H. Phelps, Jr., Apartado 7, Caracas, Venezuela, all by C. V. Duff.

The president appointed C. V. Duff, E. N. Harrison, and J. R. Pemberton as a nominating committee to propose a slate of officers for 1952.

Dr. Thomas R. Howell presented a paper on "Sexual Behavior in the Brewer Blackbird."—DOROTHY E. GRONER, *Secretary*.

JANUARY.—The regular monthly meeting of the Cooper Ornithological Club was held January 22,

1952, in room 101 Architecture Building, University of Southern California. The following names were proposed for membership: Robert W. Dickerman, Arizona Coop. Wildlife Unit, University of Arizona, Tucson, Arizona, by A. R. Phillips; W. A. Elliot, 2310 S. Gilpin St., Denver 10, Colorado, by A. H. Miller; Keisuke Kobayashi, No. 2, 1-Chome, Shinohara-Kitamachi, Nada-Ku (Rokko) Kobe, Japan, by W. C. Hanna; J. George Montrello, 10851 Wilkins Ave., West Los Angeles 24, Calif., by T. R. Howell; Albert Lang Baily III, R. D. 1, Box 136-B, Littleton, Colorado, by F. H. Boynton; Mrs. W. H. Featherstone, 132 King St., Wallace, Idaho; Don C. Goodman, Zool. Dept., University of Illinois, Urbana, Illinois; Charles G. Hansen, 420 N. 16th St., Corvallis, Oregon; Francis N. Johnson, 111 Church St., Salinas, Calif.; Alfred Rodia, 1605 Grandview Ave., Martinez, Calif.; and Dorothy E. Snyder, The Peabody Museum, Salem, Mass., all by S. B. Peyton; Wayne Wilmer Bryant, Box 211, Yosemite National Park, Calif., Walter G. Cady, Norman Bridge Lab., Caltech, Pasadena 4, Calif., S. Kip Farrington, Jr., Main St., East Hampton, Long Island, N. Y., James S. Findley, Museum of Natural History, University of Kansas, Lawrence, Kansas, Mrs. Tracy C. Forward, Ione, Colorado, Frans Grootaers, de Lignestraat 12, Heverlee-Louvain, Belgium, William B. Gumbart, P. O. Box 1936, New Haven 9, Connecticut, Gerald Aubrey Hebditch, 92 Rydes Hill Road, Guildford, Surrey, England, Mrs. Elverta G. Hutchinson, R. R. 4, Box 176, Loveland, Ohio, Dr. W. K. Kraak, Bussum, Josef Israëlslaan 14, The Netherlands, Donald Edward Kunkle, 29 Edgewood Rd., Bloomfield, New Jersey, Miss Katharine Latta, 430 W. Moreland Ave., Philadelphia 18, Pennsylvania, Comdr. R. R. Lukens, 8205 Victoria Ave., Riverside, Calif., J. Edwin Moncrieff, 2745 E. 8th St., National City, Calif., J. P. Mackie Niven, Amanzi, Uitenhage, Union of So. Africa, Fernando Costa Novaes, Aptd. 303, Rua Toneleiros 186, Copacabana, Rio de Janeiro, Brazil, Robert Pickering, 66 Menno St., Waterloo, Ontario, Canada, Maud Barroll Ransom, Box 557, Portland 7, Oregon, Robert H. Sehl, 7027 Hegerman St., Philadelphia 35, Pennsylvania, W. Glen Smith, Box 240, Little Mt. Camp, Vancouver 13, B. C., Canada, James M. Stauffer, Haugen, Wisconsin, and Charles M. Weise, Vivarium Bldg., University of Illinois, Urbana, Illinois, all by C. V. Duff.

C. V. Duff, reporting for the Nominating Committee, presented the names of W. J. Sheffler for president; Wade Fox, Jr., for first vice-president; Jean Delacour, for second vice-president; and Dorothy E. Groner, for secretary. There being no further nominations, it was moved by Sidney B. Peyton, and duly seconded, that the nominations be closed, and that the secretary be instructed to cast an unanimous ballot for the slate as proposed. So carried. Officers duly elected. On behalf of the Club, C. V. Duff thanked the outgoing officers for the splendid work done during the past year.

S. Dillon Ripley, Associate Curator of the Peabody Museum, Yale University, was introduced by Kenneth Stager, and presented a colored motion picture of his recent ornithological expedition into Nepal.—DOROTHY E. GRONER, *Secretary*.

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FOR SALE—Dawson's Birds of California, 4-volume de luxe edition, 110 color plates, bound in green buckram, in fine condition. Price, $75.00, or make an offer.—L. B. CHAPMAN, *1 Woodridge Road, Wellesley 81, Mass.*

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FIELD GLASSES—During March and April we offer Condor readers without charge reprints of our article "Know Your Binoculars," recently published in Audubon Magazine. Fully illustrated, it tells how to choose, use and check a binocular for birding. If your glass needs repair or coating, send it to us for free estimate. If you need a new one, send for free list of glasses from $12 to $150—all guaranteed adjusted to U. S. Government specifications, and sent on 20 days' free trial. Liberal trade-in. We also check glasses without charge; let us help you solve your binocular problem.—THE REICHERTS, *Mirakel Repair Co., Mount Vernon 15, N.Y.*

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